Faculty of Engineering & Technology

Electrical & Computer Engineering Department

DIGITAL SIGNAL PROCESSING (DSP) ENCS 4310

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Instructor:

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Section: 2

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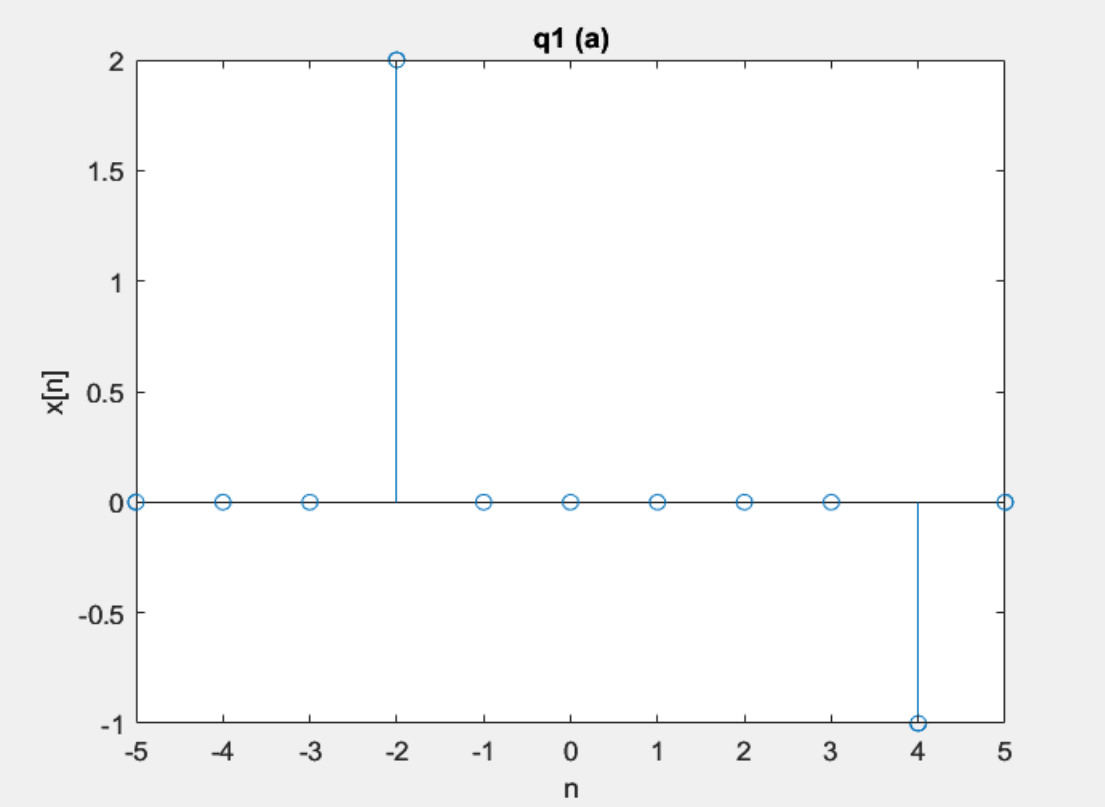
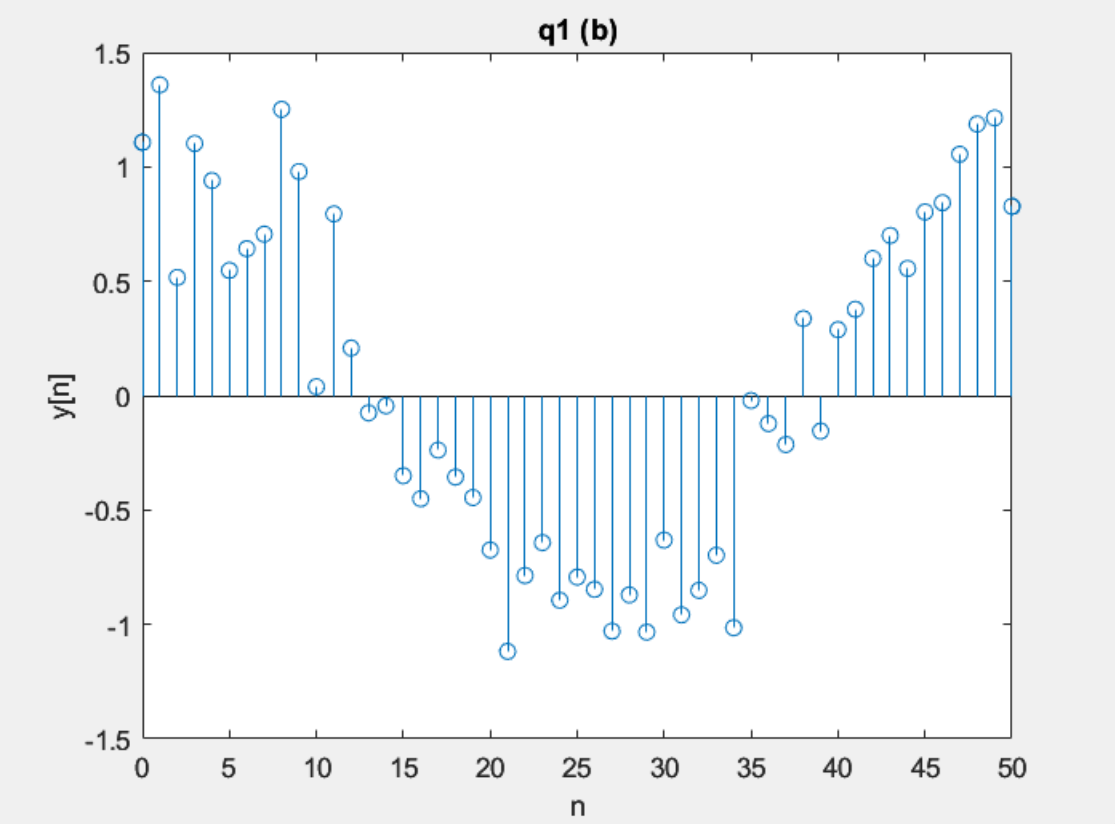
Q1_a:

```
n=-5:5;
delta_n=[0,0,0,2,0,0,0,0,0,-1,0];
stem(n,delta_n);
title('q1 (a)')
xlabel('n');
ylabel('x[n]');
```



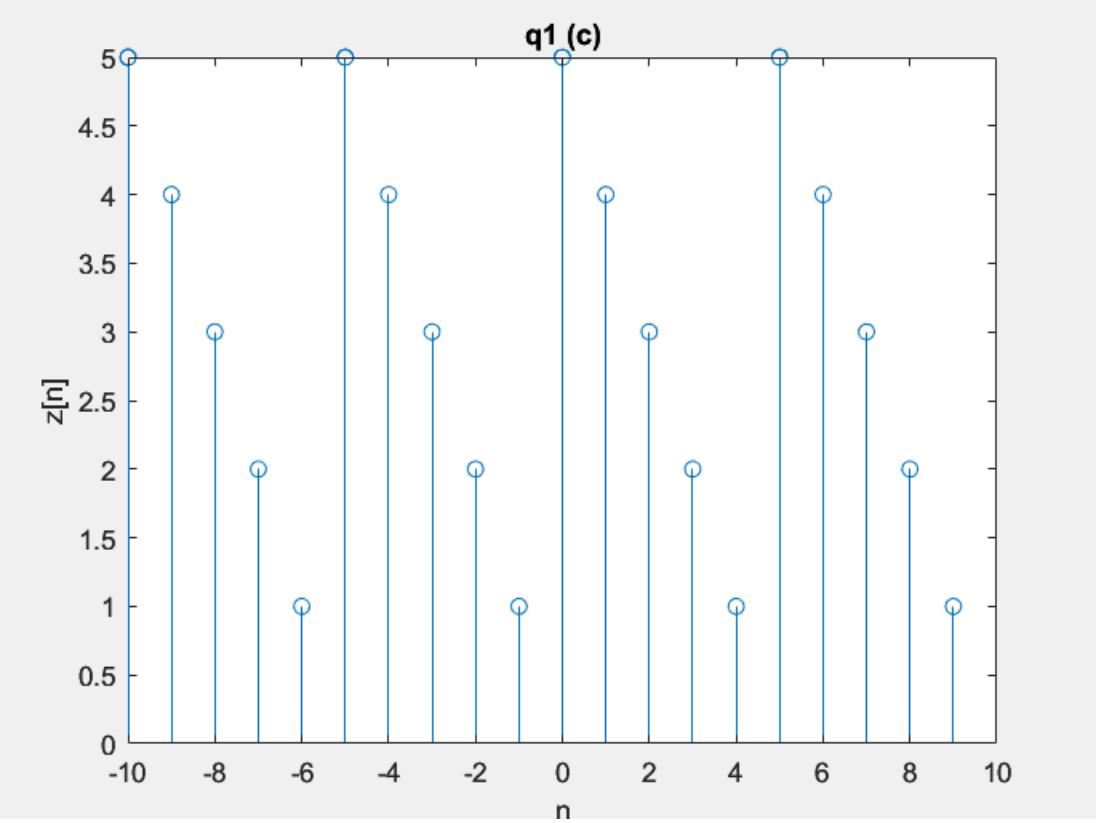
Q1_b:

```
n=linspace(0,50,51);
y_n=cos(0.04*pi*n)+0.2*randn(size(n));
stem(n,y_n)
title('q1 (b)')
xlabel('n');
ylabel('y[n]');
```



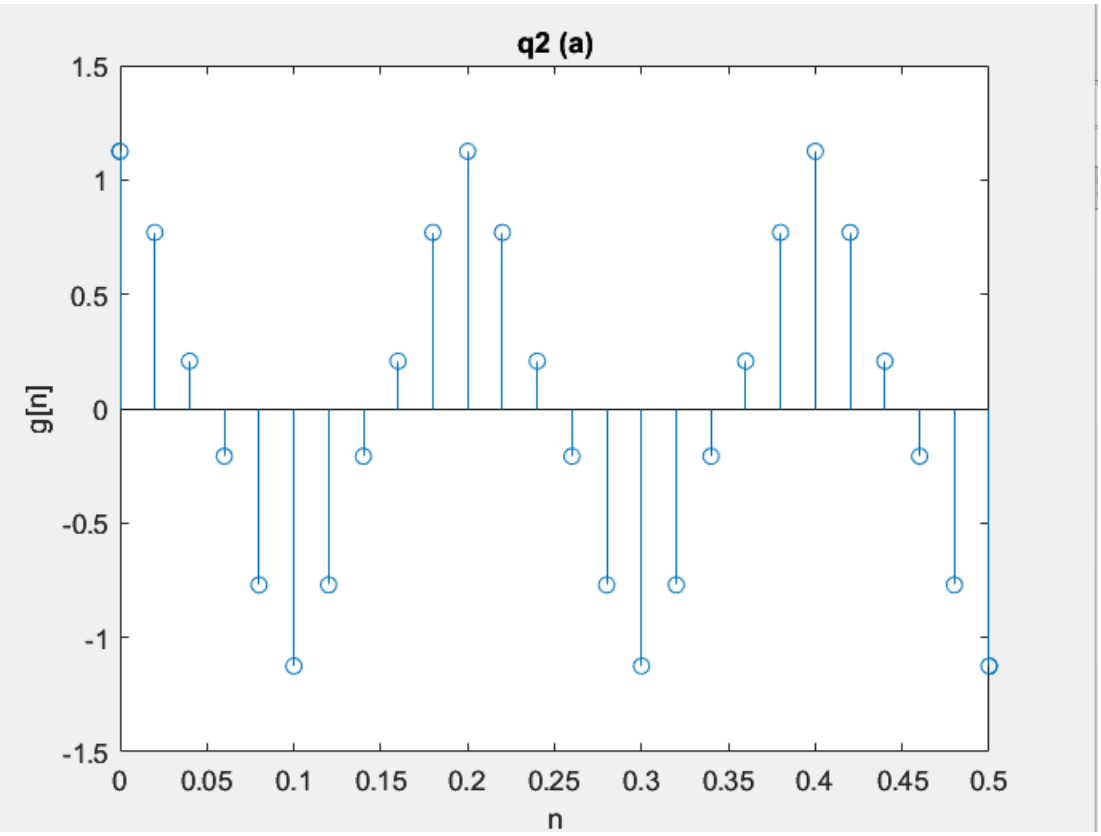
Q1_c:

```
n=-10:9;
delta_n=[5,4,3,2,1,5,4,3,2,1,5,4,3,2,1,5,4,3,2,1];
stem(n,delta_n);
title('q1 (c)')
xlabel('n');
ylabel('z[n]');
```



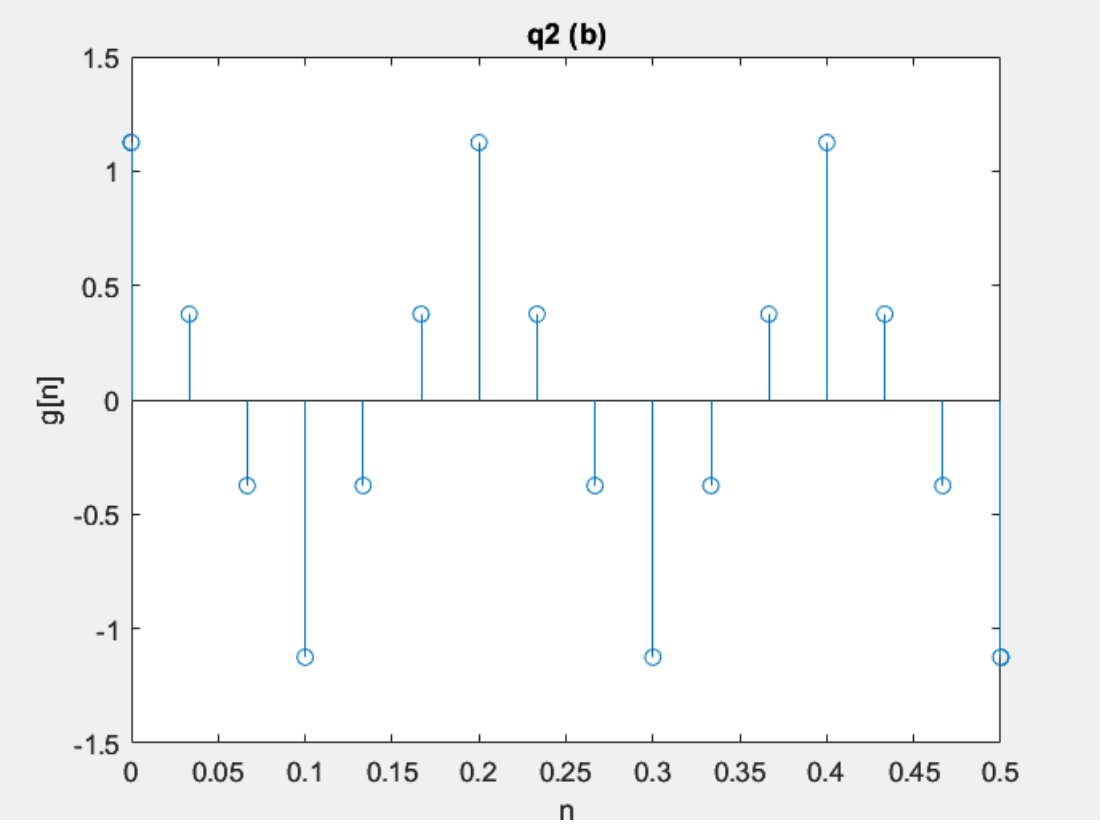
Q2_a:

```
n=0:1/50:0.5;
F1=5;
F2=15;
g_n=cos(2*pi*F1*n)+0.125*cos(2*pi*F2*n);
stem(n,g_n);
title('q2 (a)');
xlabel('n');
ylabel('g[n]');
```



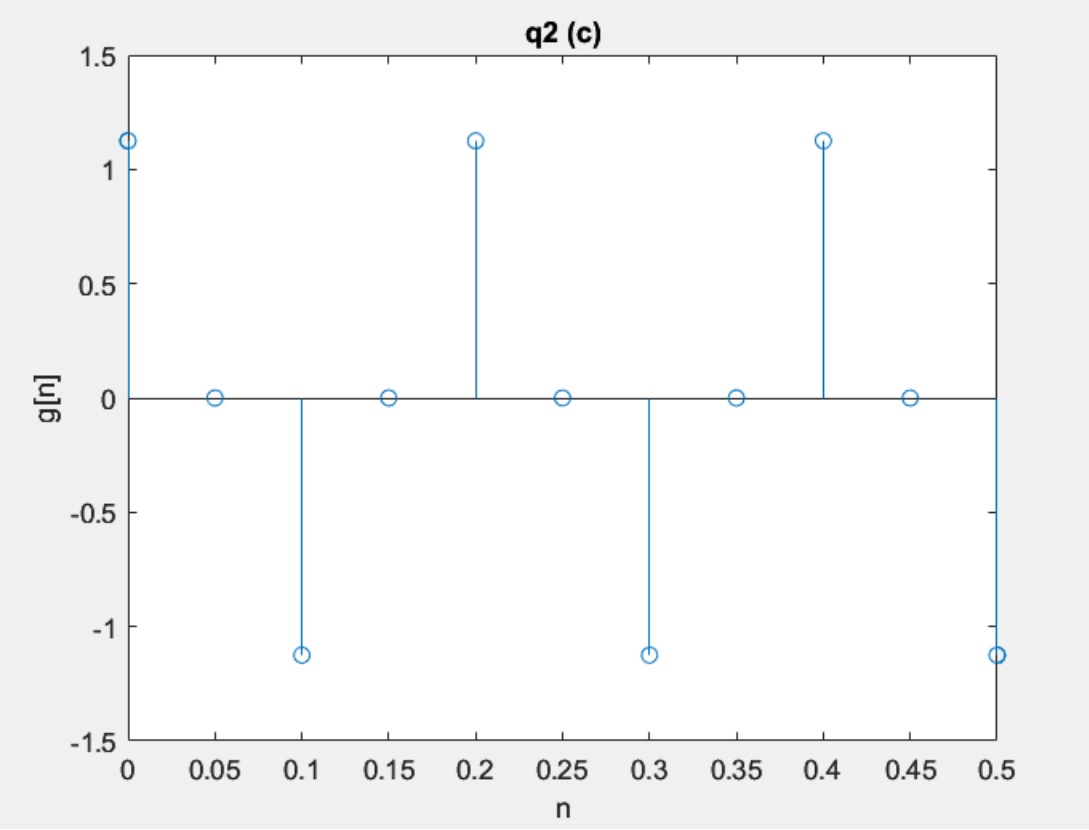
Q2_b:

```
n=0:1/30:0.5;
F1=5;
F2=15;
g_n=cos(2*pi*F1*n)+0.125*cos(2*pi*F2*n);
stem(n,g_n);
title('q2 (b)');
xlabel('n');
ylabel('g[n]');
```



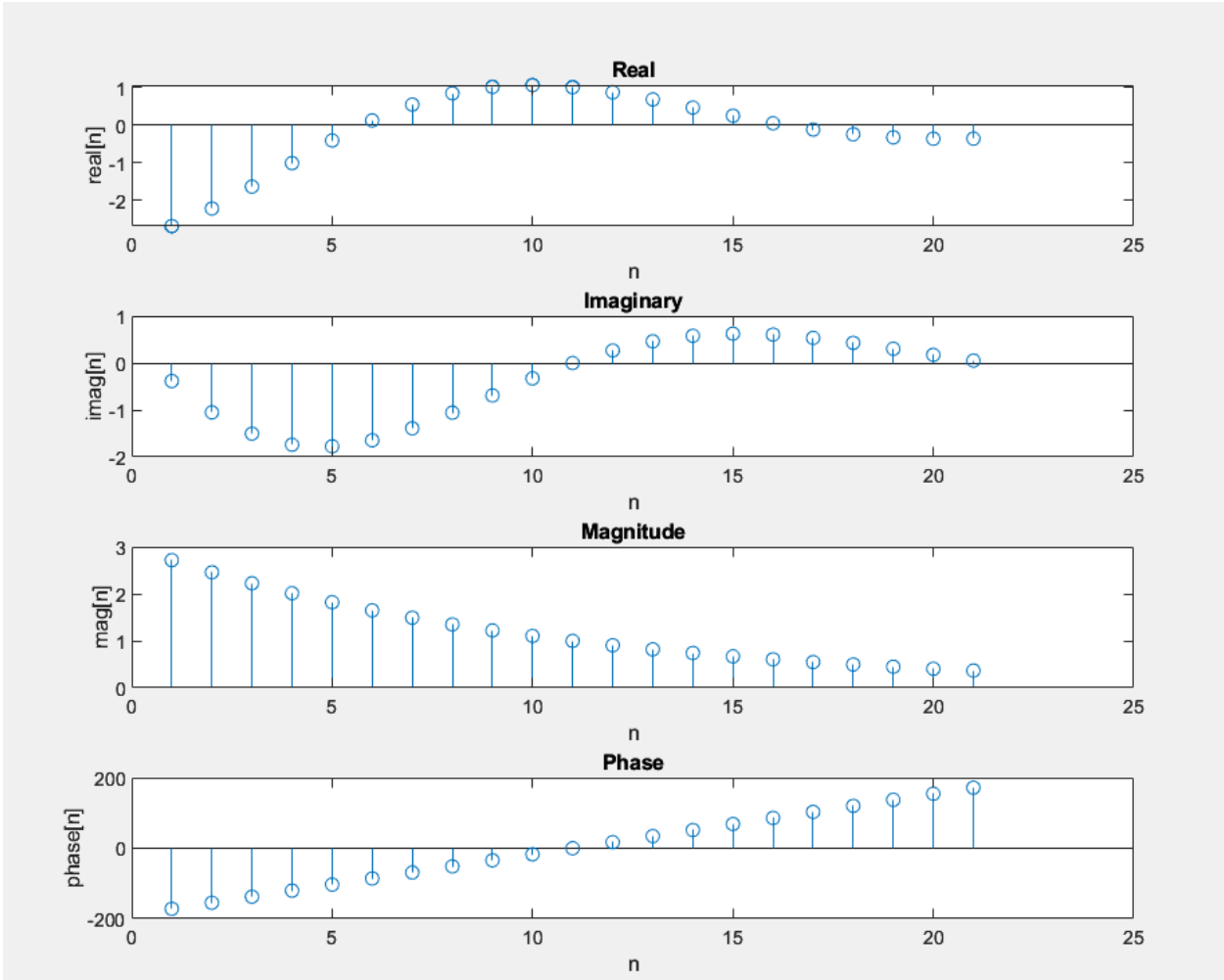
Q2_c:

```
n=0:1/20:0.5;
F1=5;
F2=15;
g_n=cos(2*pi*F1*n)+0.125*cos(2*pi*F2*n);
stem(n,g_n);
title('q2 (c)');
xlabel('n');
ylabel('g[n]');
```



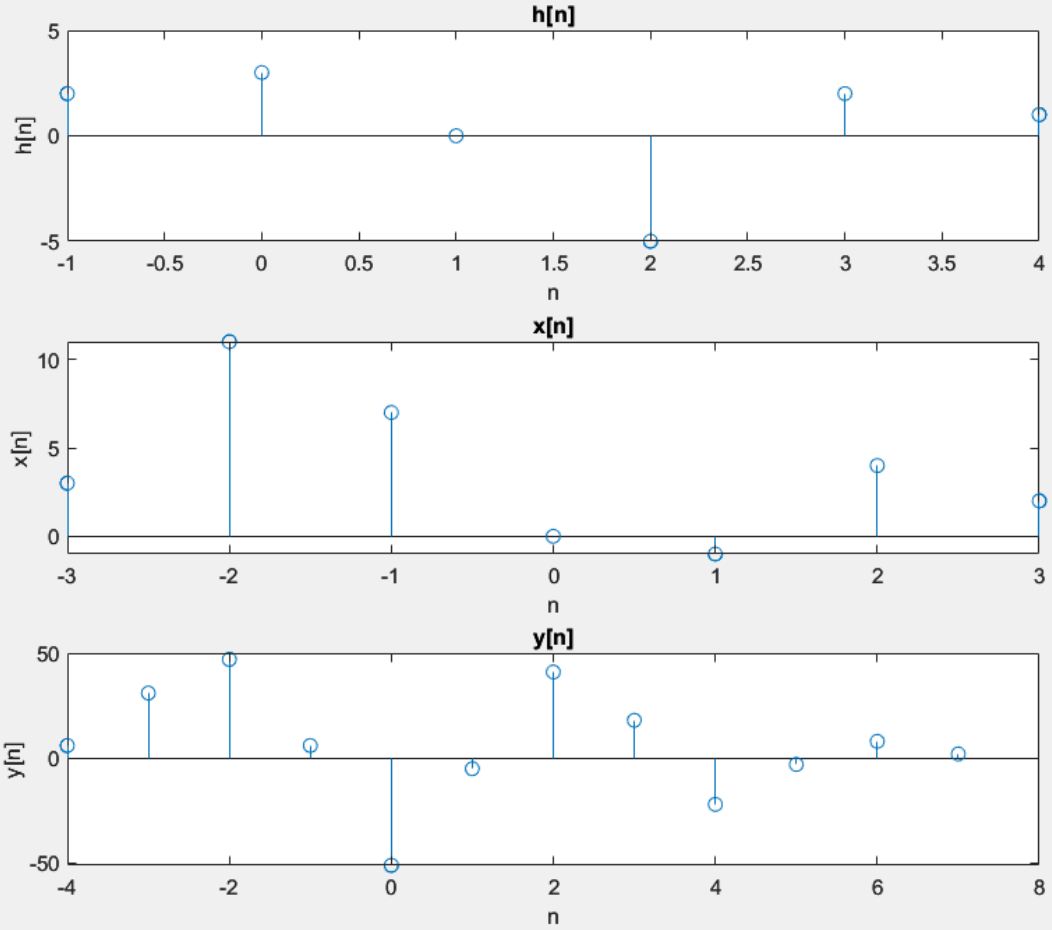
Q3:

```
n=-10:10;
x_n= exp((-0.1+j*0.3)*n);
subplot(4,1,1);
stem(real(x_n));
title('Real');
xlabel('n');
ylabel('real[n]');
subplot(4,1,2);
stem(imag(x_n));
title('Imaginary');
xlabel('n');
ylabel('imag[n]');
subplot(4,1,3);
stem(abs(x_n));
title('Magnitude');
xlabel('n');
ylabel('mag[n]');
subplot(4,1,4);
stem((180/pi)*angle(x_n));
title('Phase');
xlabel('n');
ylabel('phase[n]');
```


Real
real[n]
n
Imaginary
imag[n]
n
Magnitude
mag[n]
n
Phase
phase[n]
n

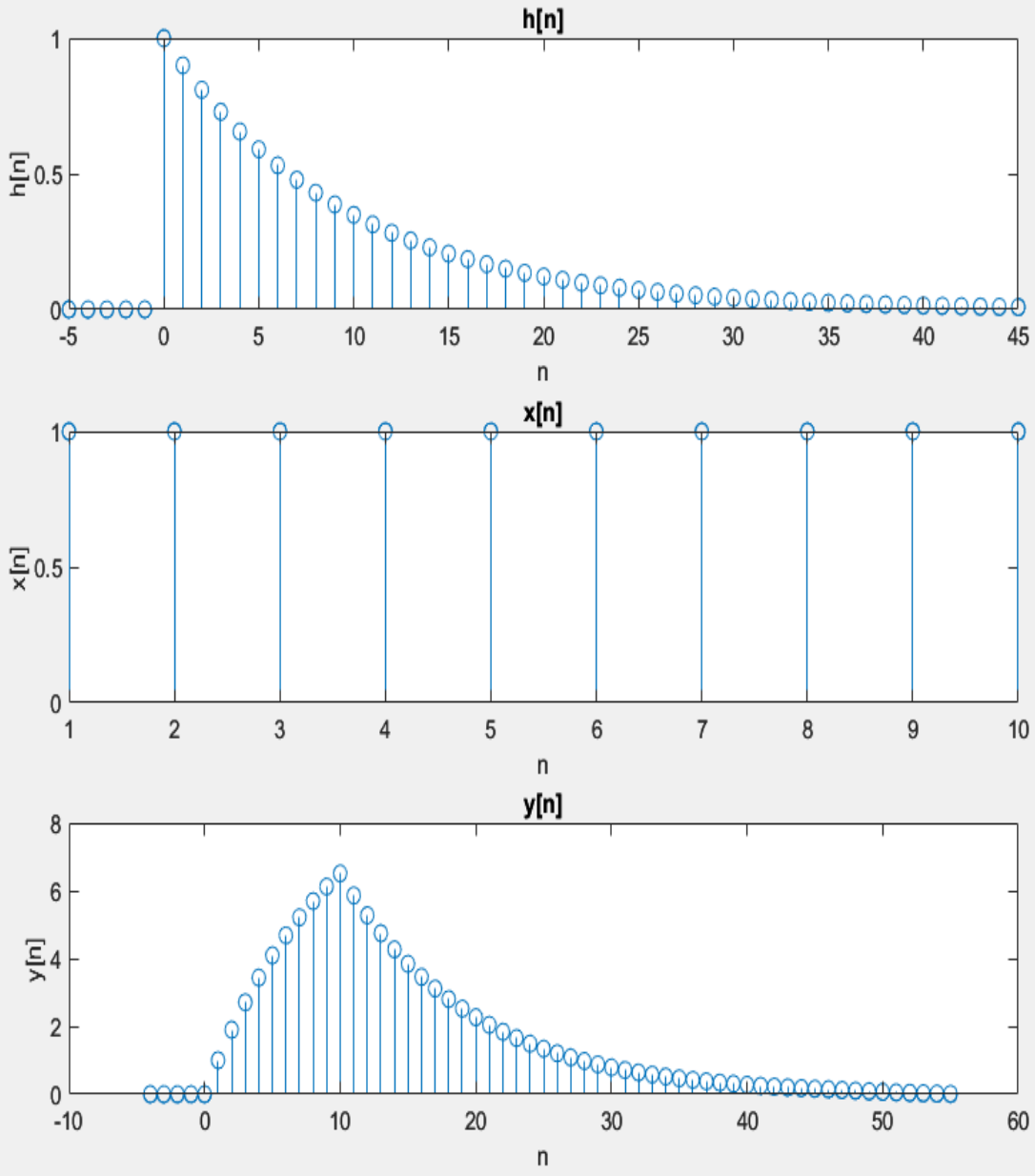
Q5:

```
m=-1:4;
n=-3:3;
c=-4:7;
x_n=[3,11,7,0,-1,4,2];
h_n=[2,3,0,-5,2,1];
y_n=conv(x_n,h_n);
subplot(3,1,1);
stem(m,h_n);
title('h[n]');
xlabel('n');
ylabel('h[n]');
subplot(3,1,2);
stem(n,x_n);
title('x[n]');
xlabel('n');
ylabel('x[n]');
subplot(3,1,3);
stem(c,y_n);
title('y[n]');
xlabel('n');
ylabel('y[n]');
```


h[n]
h[n]
n
x[n]
x[n]
n
y[n]
y[n]
n

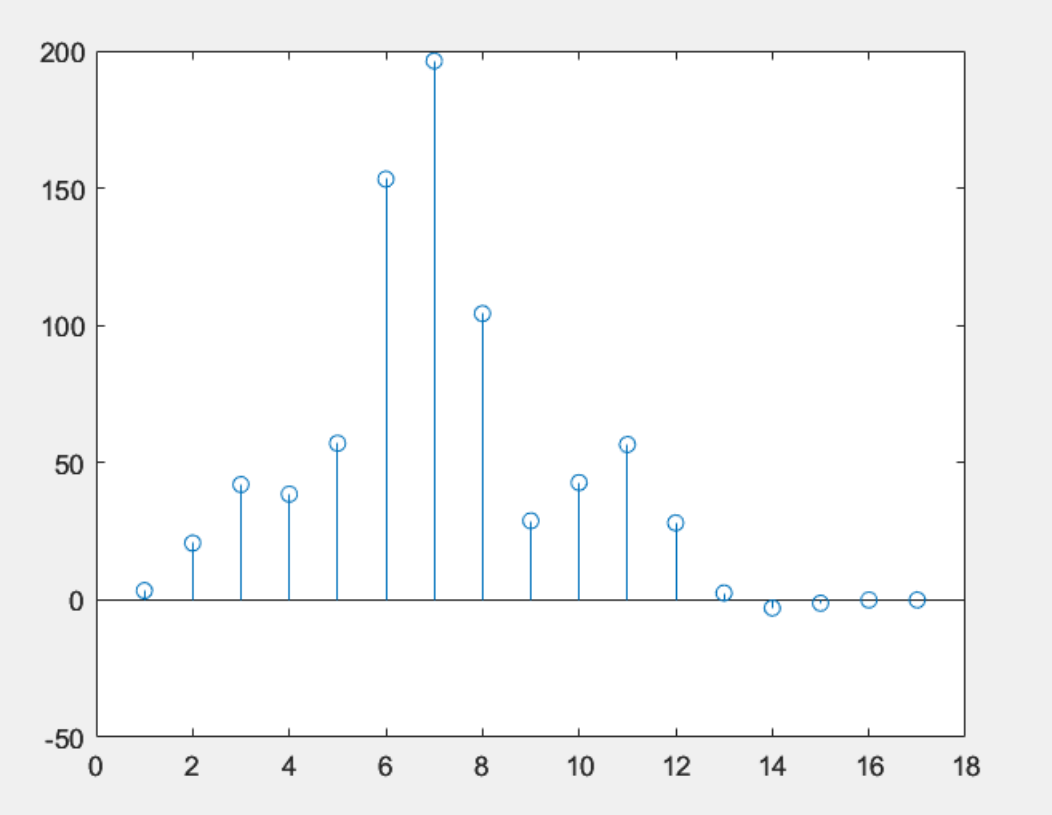
Q6:

```
n=-5:1:45;
m=1:10;
c=-4:55
x=ones(1,10);
r=(n>=0);
h = (0.9.^(n)).*r;
y=conv(x,h)
subplot(3,1,1);
stem(n,h);
title('h[n]');
xlabel('n');
ylabel('h[n]');
subplot(3,1,2);
stem(m,x);
title('x[n]');
xlabel('n');
ylabel('x[n]');
subplot(3,1,3);
stem(c,y);
title('y[n]');
xlabel('n');
ylabel('y[n]');
```


h[n]
h[n]
n
x[n]
x[n]
n
y[n]
y[n]
n

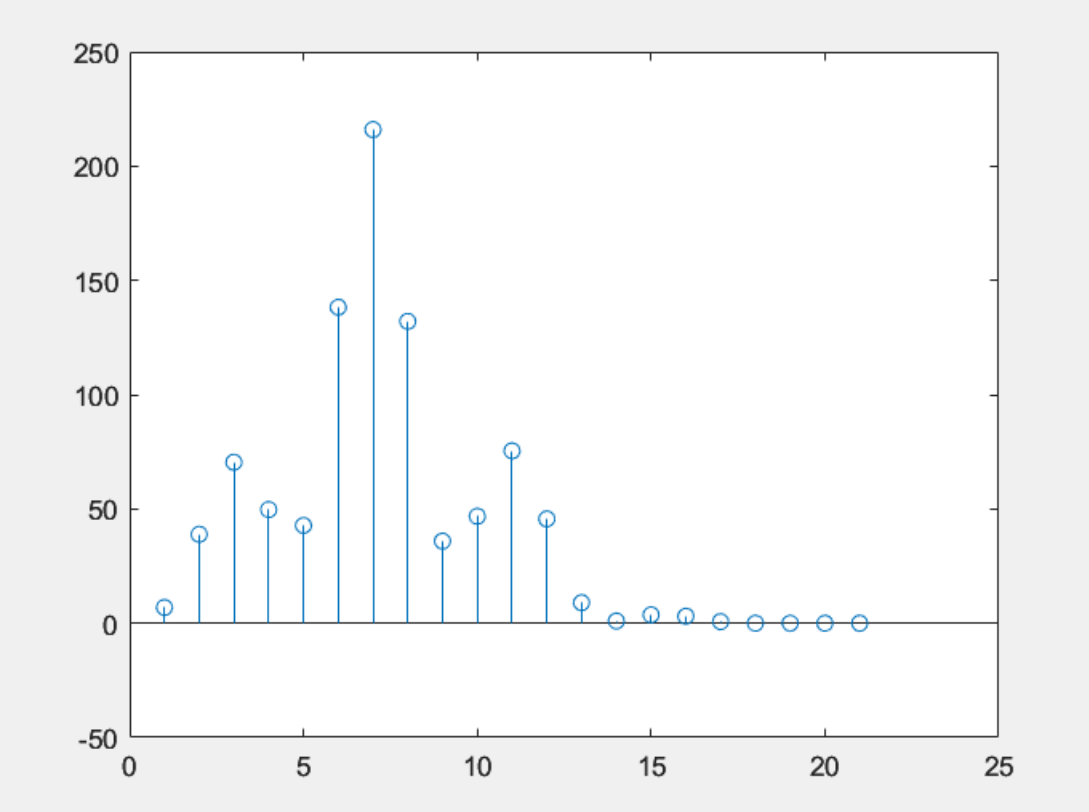
Q7_a:

```
n= linspace(0,8,9);

m=0:8;

c=linspace(1,17,17);

x  = [3,11,7,0,1,4,2];

B = zeros(1,9);

B(3:end) = x(1:7);

w=rand(size(n));

y= B + randn(size(n));

z=xcorr(x,y);

size(z)

stem(c,z)
```



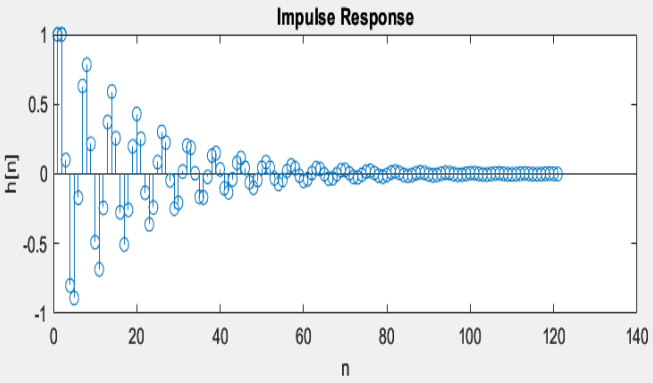
Q7_b:

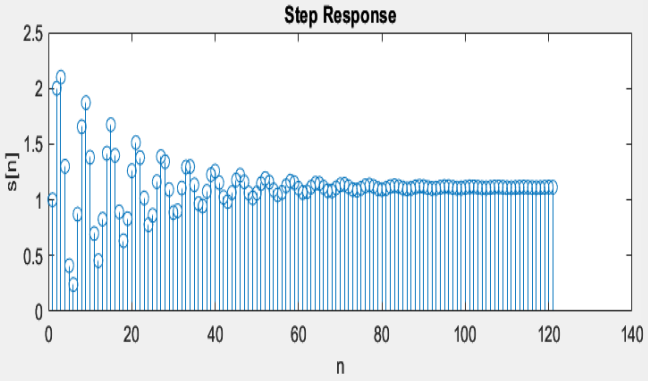
```
n= linspace(0,10,11);
m=0:10;
c=linspace(1,21,21);
x  = [3,11,7,0,1,4,2];
B = zeros(1,11);
B(5:end) = x(1:7);
y= B + rand(size(n));
z=xcorr(x,y);
size(z)
stem(c,z)
```

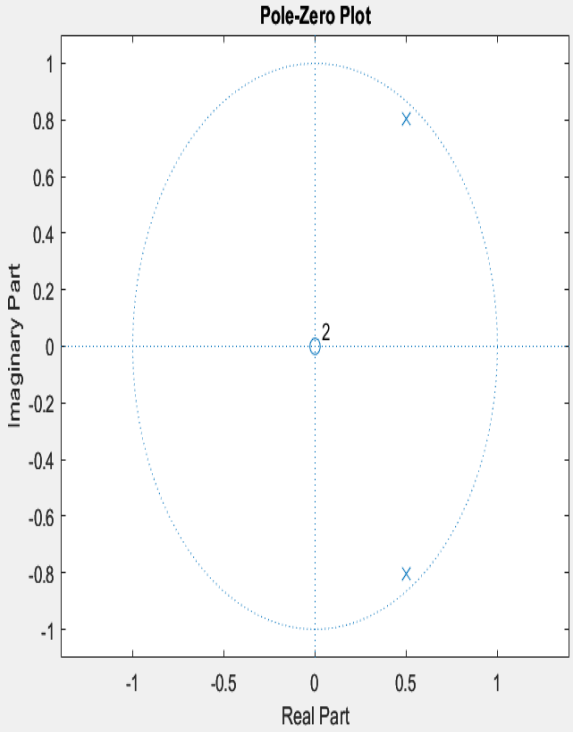


Q8:

```
n=-5:1:120;


x_n = [1, zeros(1, 120)];
h=filter(1,[1,-1,0.9],x_n);
subplot(2,1,1)
stem(h);
xlabel('n');
ylabel('h[n]')
title('Impulse Response')


x_n=[1, ones(1, 120)];
s=filter(1,[1,-1,0.9],x_n);
subplot(2,1,2)
stem(s);
xlabel('n');
ylabel('s[n]')
title('Step Response')


figure;
zplane(1,[1,-1,0.9])
poles = roots([1,-1,0.9]);
if max(abs(poles)) < 1
   disp('Stable');
else
   disp('Unstable');
end
```


Impulse Response
h[n]
n

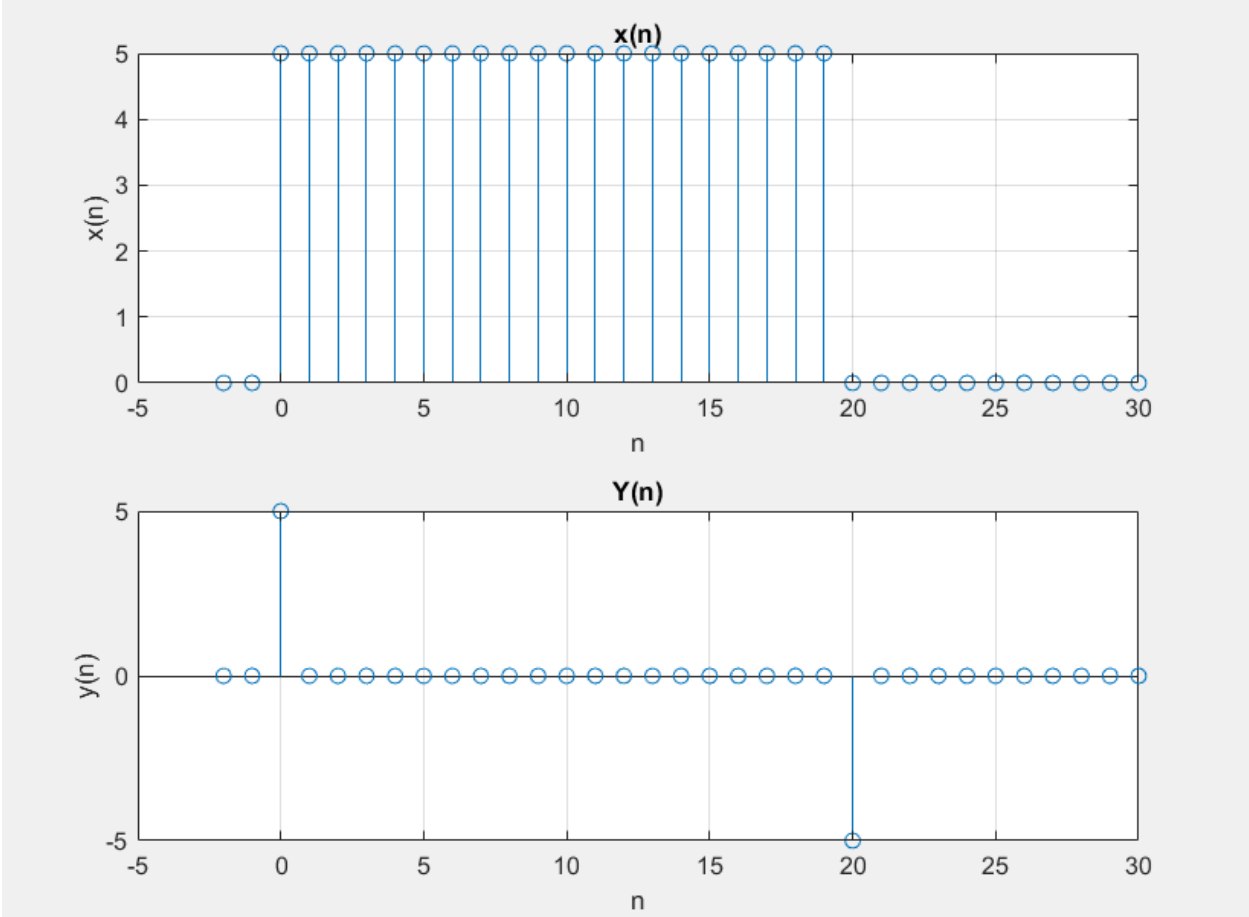

Step Response
s[n]
n


Pole-Zero Plot
Imaginary Part
Real Part
2

```
>> q8a
Stable
>>
```

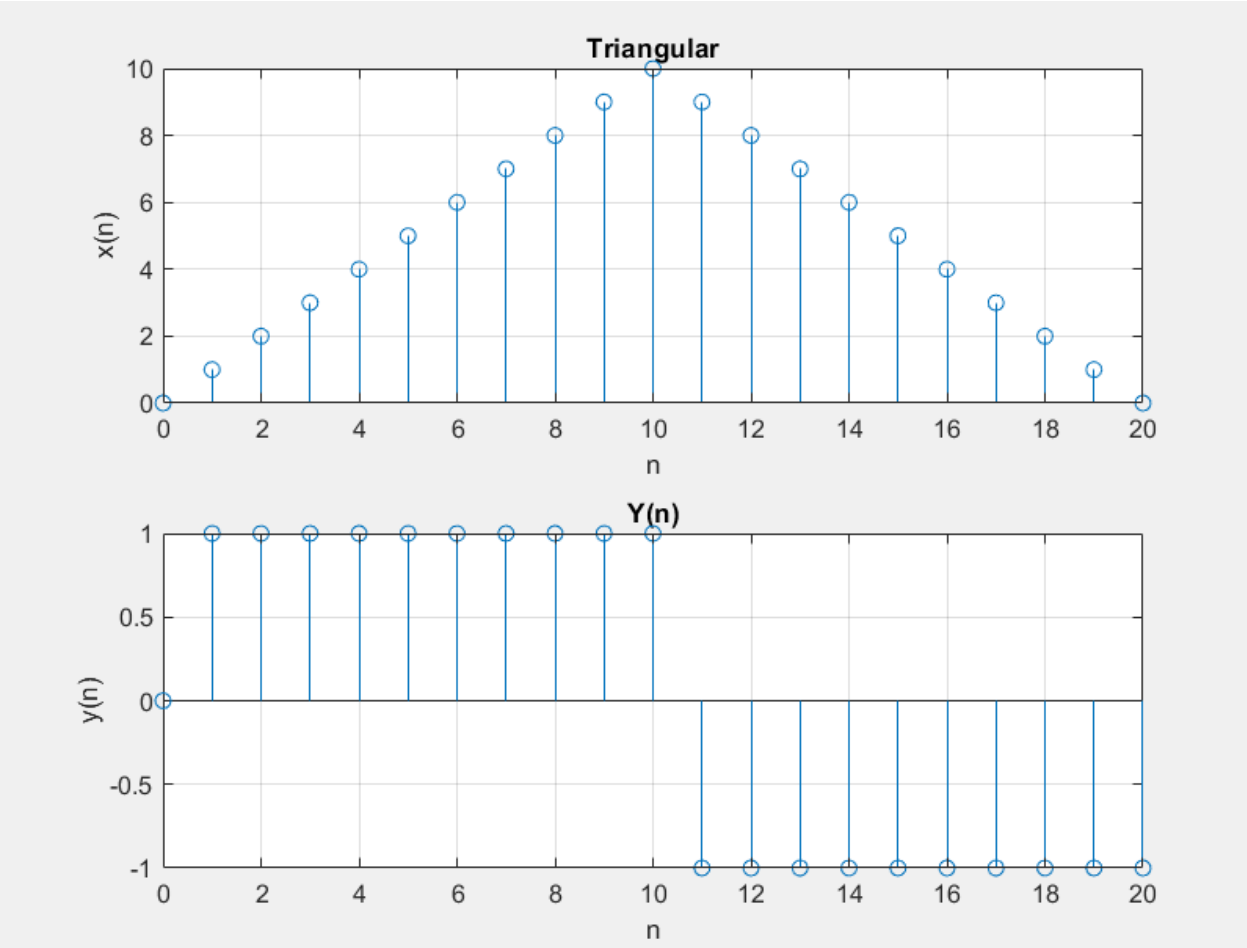
Q9_a:

```
n=-2:1:30;
x=5*((n>=0)-(n>=20));
y=filter([1 -1],1,x);

figure;
subplot(2,1,1)
stem(n,x)
xlabel('n')
ylabel('x(n)')
grid on;
title('x(n)')

subplot(2,1,2)
stem(n,y)
xlabel('n')
ylabel('y(n)')
grid on;
title('Y(n)')
```


x(n)
x(n)
n
Y(n)
y(n)
n

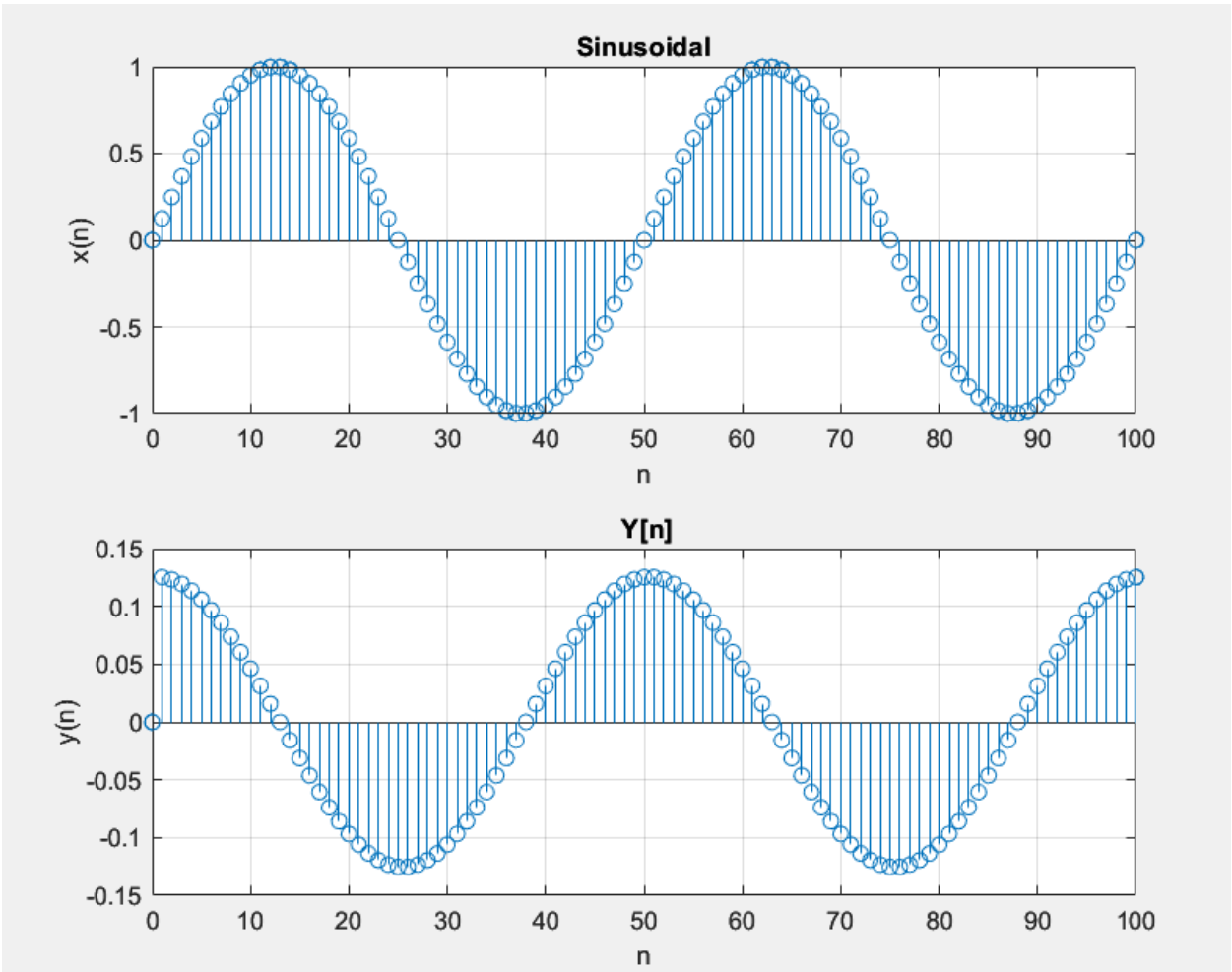
Q9_b:

```
n=0:1:20;
x=[n.*((n>=0)-(n>=10))]+[(20-n).*((n>=10)-(n>=20))]
y=filter([1 -1],1,x)

figure;
subplot(2,1,1)
stem(n,x)
xlabel('n')
ylabel('x(n)')
grid on;
title('Triangular')

subplot(2,1,2)
stem(n,y)
xlabel('n')
ylabel('y(n)')
grid on;
title('Y(n)')
```


Triangular
x(n)
n
Y(n)
y(n)
n

Q9_c:

```
n=0:1:100;
x=(sin(pi*n/25)).*[(n>=0)-(n>=100)];
y=filter([1 -1],1,x)

figure;
subplot(2,1,1)
stem(n,x)
xlabel('n')
ylabel('x(n)')
grid on;
title('Sinusoidal')

subplot(2,1,2)
stem(n,y)
xlabel('n')
ylabel('y(n)')
grid on;
title(' Y[n]')
```

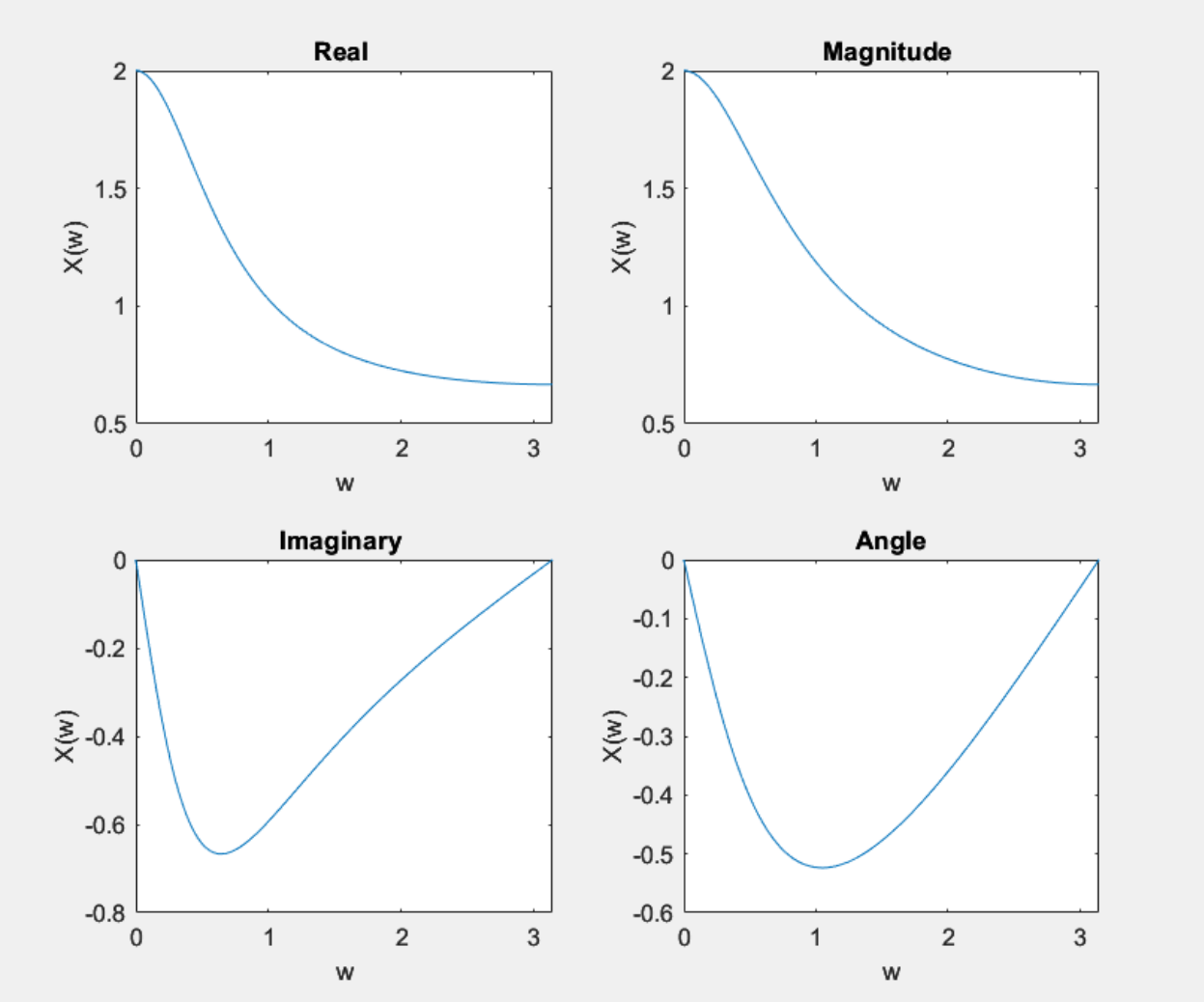

Sinusoidal
x(n)
n
Y[n]
y(n)
n

Q10:

```
k=0:500;
w = k*(pi/500);
X = exp(j*w) ./ ((exp(j*w) - 0.5*ones(1,501)));

subplot (2 ,2 ,1) ;
plot(w, real(X))
xlabel('w')
ylabel('X(w)')
title('Real ')

subplot (2 ,2 ,3) ;
plot(w, imag(X))
xlabel('w')
ylabel('X(w)')
title('Imaginary ')


subplot (2 ,2 ,2) ;
plot(w, abs(X))
xlabel('w')
ylabel('X(w)')
title('Magnitude ')

subplot (2 ,2 ,4)
plot(w, angle(X))
xlabel('w')
```

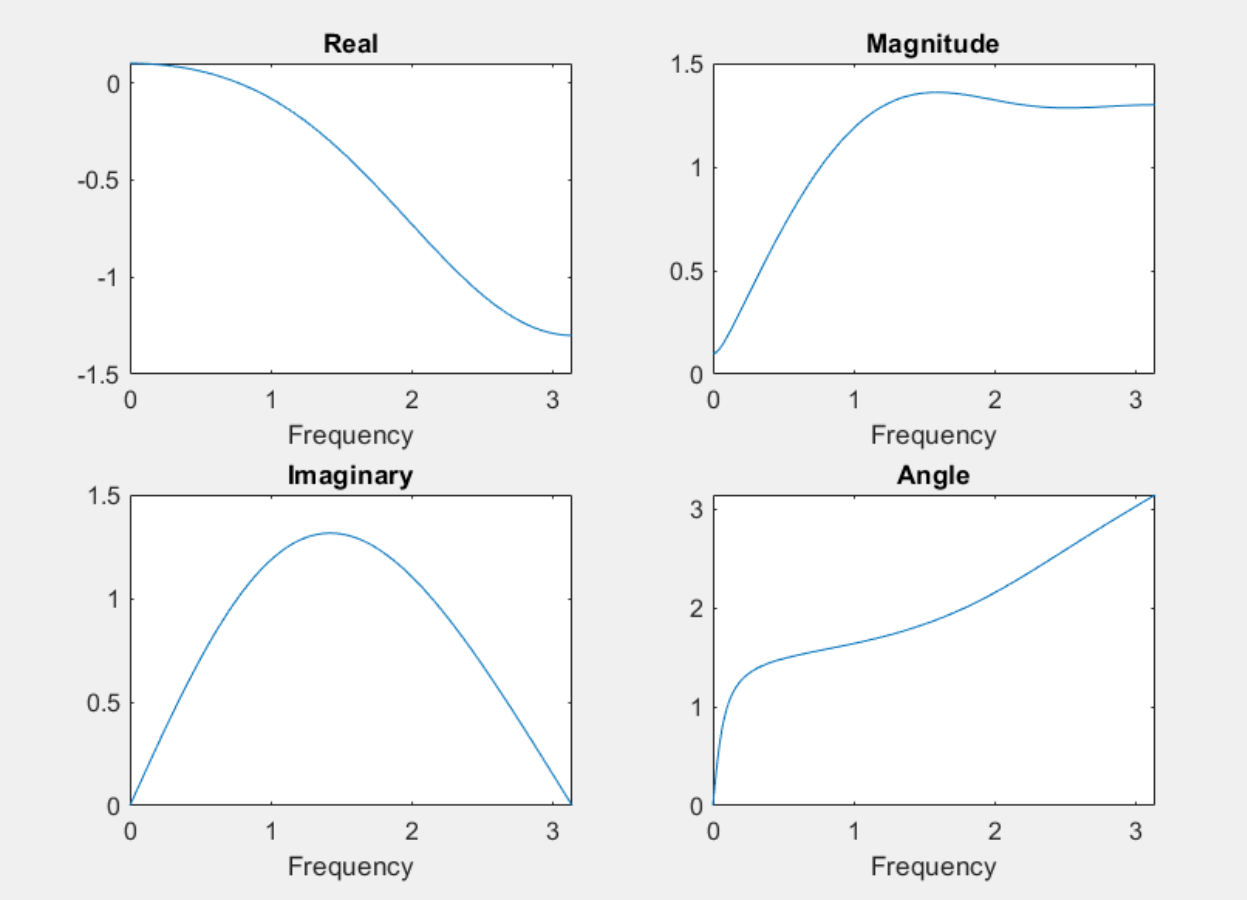
ylabel('X(w)')

title('Angle')



Q11:

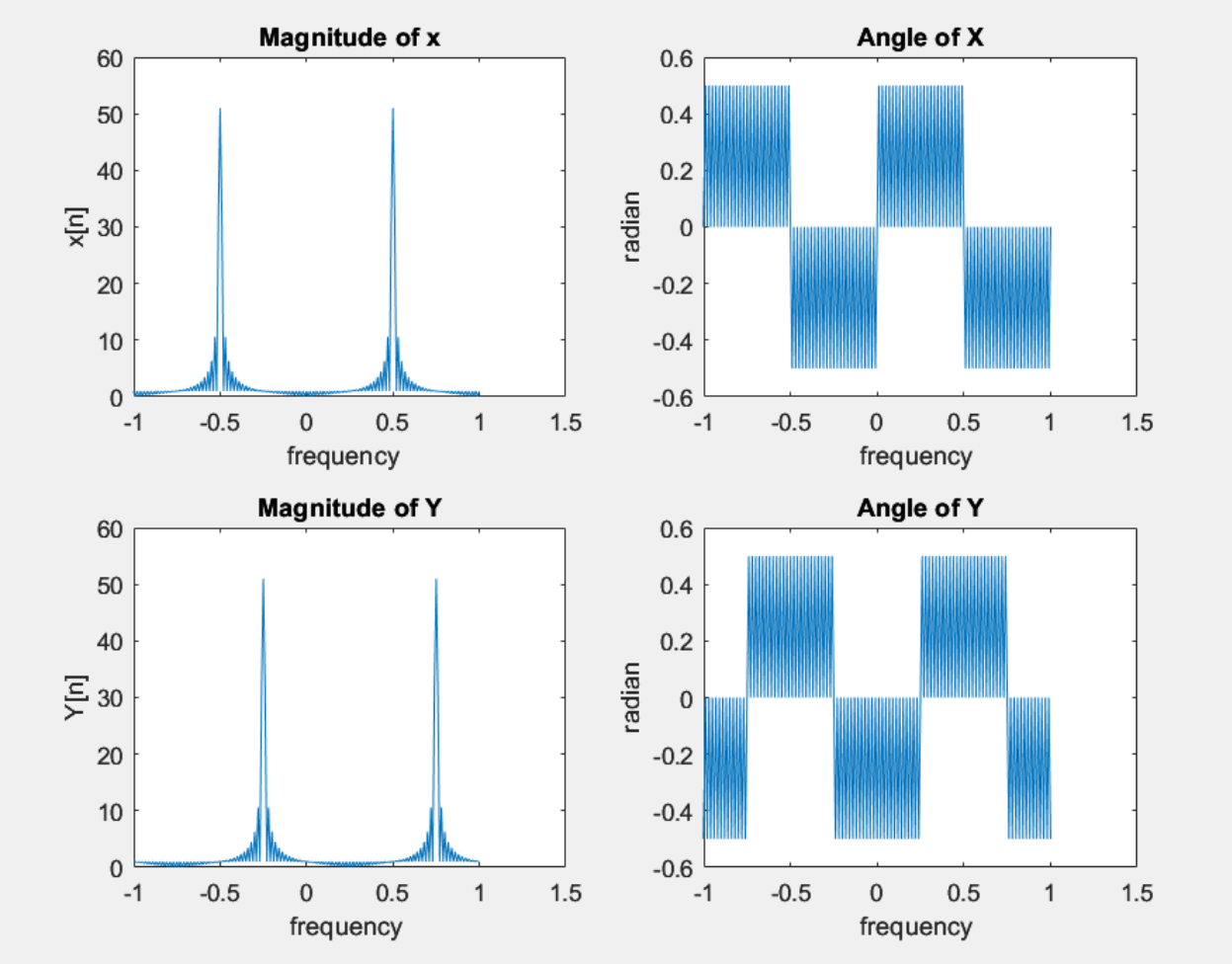
```
n = -1:2;
x=[1,-0.5,-0.3,-0.1];
k = 0:500;
w = (pi/500)*k;
X = x*(exp(-i*pi/500)) .^ (n'*k);


subplot(2 ,2 ,1);
plot(w, real(X));
title('Real');
xlabel('Frequency');

subplot(2 ,2 ,3);
plot(w, imag(X));
title('Imaginary');
xlabel('Frequency');

subplot(2 ,2 ,2);
plot(w, abs(X));
title('Magnitude');
xlabel('Frequency');

subplot(2 ,2 ,4);
plot(w, angle(X));
title('Angle');
xlabel('Frequency');
```


Real
0
-0.5
-1
-1.5
0
1
2
3
Frequency
Magnitude
1.5
1
0.5
0
0
1
2
3
Frequency
Imaginary
1.5
1
0.5
0
0
1
2
3
Frequency
Angle
3
2
1
0
0
1
2
3
Frequency

Q12:

```
n = 0:100;
k = -100:100;
w = (pi/100)*k;
X = cos(pi*n/2) * (exp(-1j*pi/100)).^(n'*k);
Y = exp(1j*pi*n/4).*cos(pi*n/2)*(exp(-1j*pi/100)).^(n'*k);

  subplot(2,2,1);
  plot(w/pi,abs(X));
  xlabel('frequency  ');
  ylabel('x[n]')
  title('Magnitude of x')

  subplot(2,2,2);
  plot(w/pi,angle(X)/pi);
  xlabel('frequency ');
  ylabel('radian')
  title('Angle of X')

  subplot(2,2,3);
  plot(w/pi,abs(Y));
  xlabel('frequency ');
  ylabel('Y[n]')
  title('Magnitude of Y')

  subplot(2,2,4);
  plot(w/pi,angle(Y)/pi);
```

```
xlabel('frequency ');
ylabel('radian')
title('Angle of Y')
```



We notice that Y[n] is shift of x[n] by 0.25.

Done