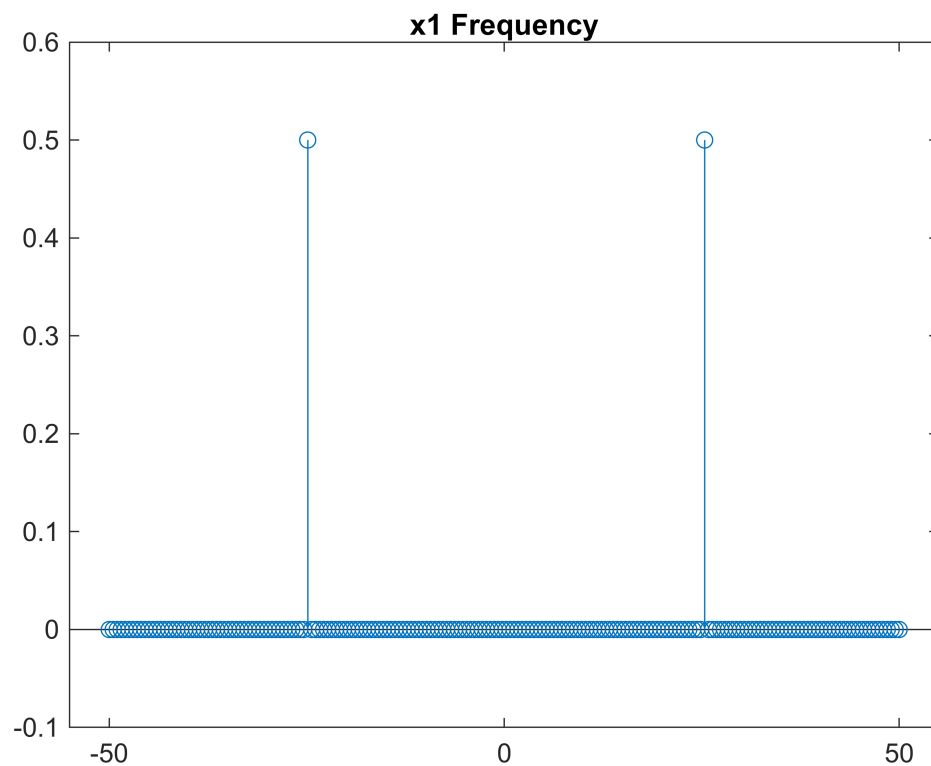```
A = 1;
f = 25;
T = 2;
F_s = 100;
x_1 = gen(A, f, T, F_s);
f_axis1 = linspace(-F_s/2, F_s/2, length(x_1));
x_1_fft= fftshift(fft(x_1),length(x_1));

figure(1);
stem(f_axis1,abs(x_1_fft)/length(x_1))
title('x1 Frequency')
ylim([-0.1 0.6])
xlim([-55 55])
```
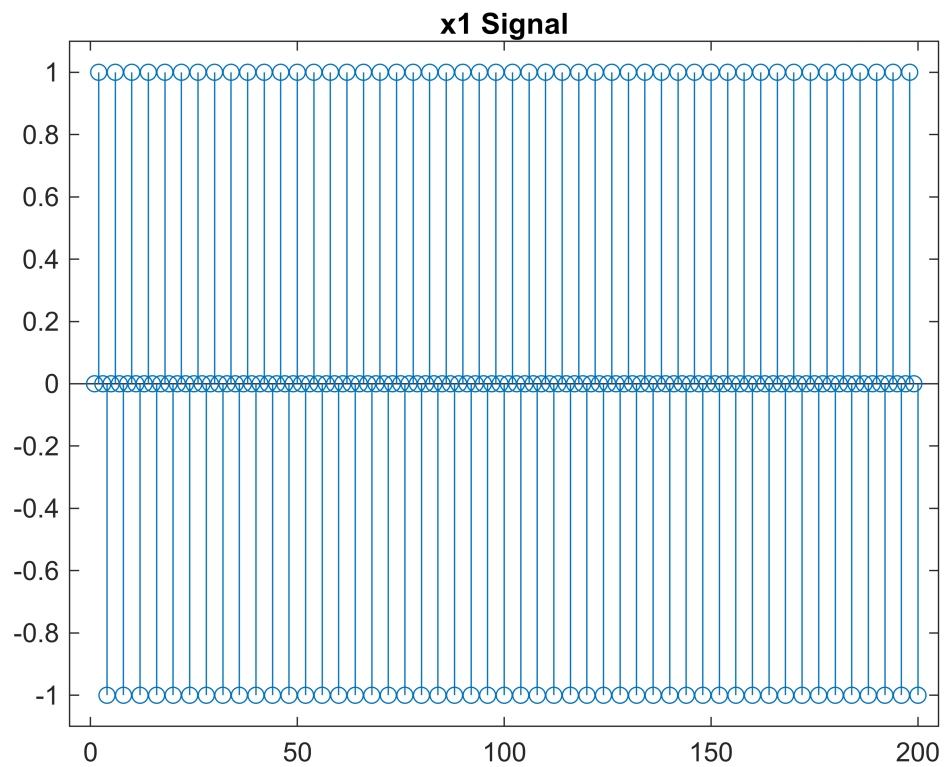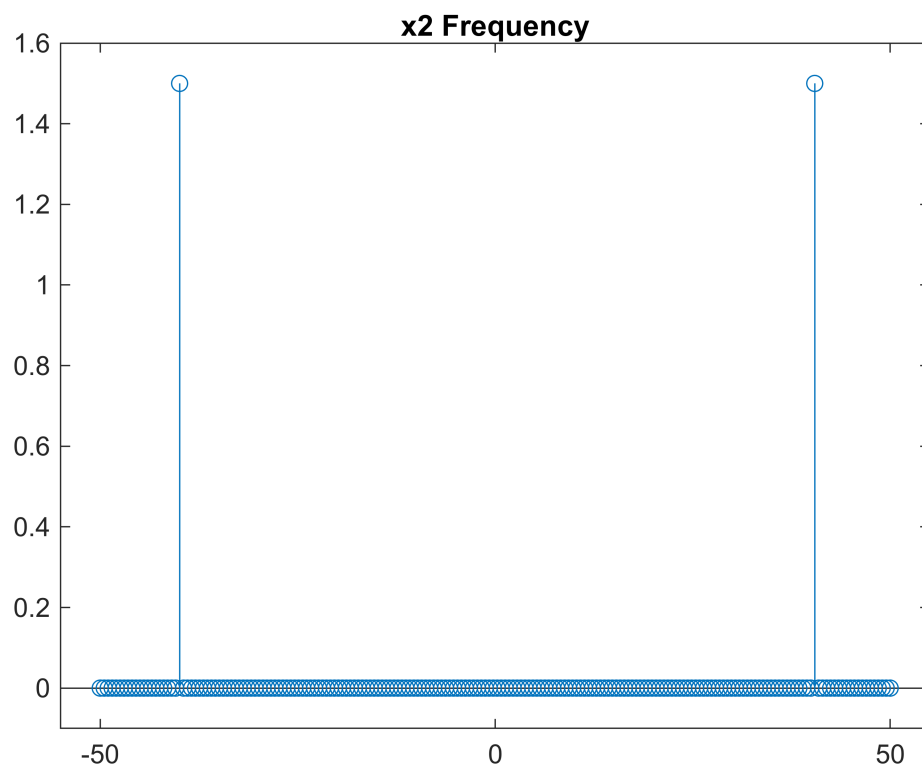


```
figure(2);
stem(x_1)
title('x1 Signal')
ylim([-1.1 1.1])
xlim([-5 205])
```
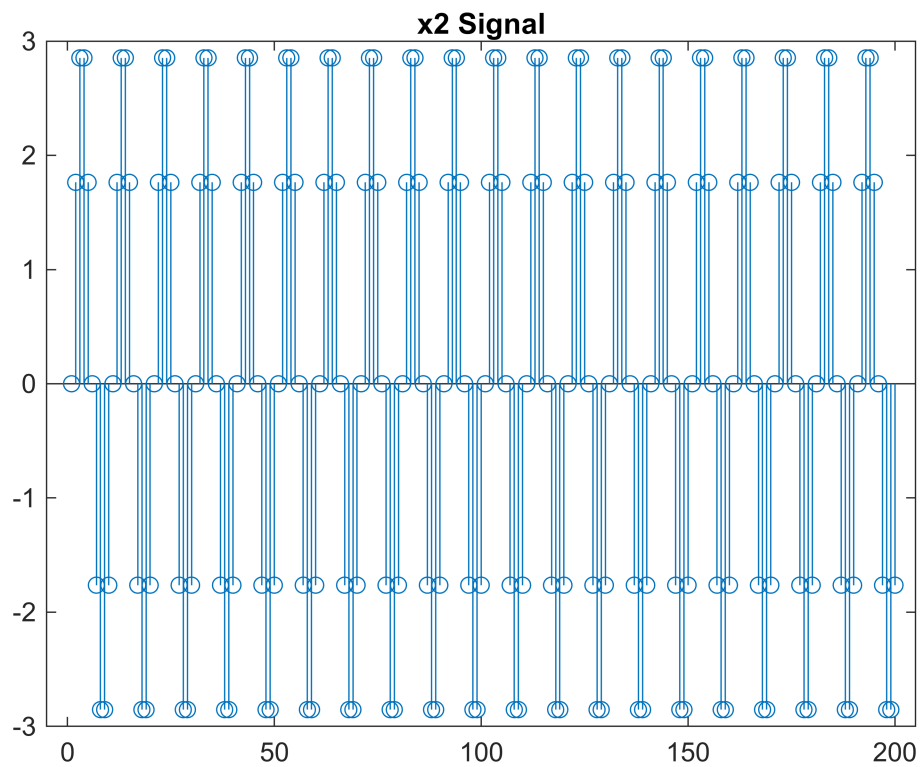
## x1 Signal



```
A = 3;
f = 10;
T = 2;
F_s = 100;
x_2 = gen(A, f, T, F_s);
x_2_fft=fftshift(fft(x_2),length(x_2));
f_axis2 = linspace(-F_s/2, F_s/2, length(x_2));

figure(3);
stem(f_axis2,abs(x_2_fft)/length(x_2))
title('x2 Frequency')
ylim([-0.1 1.6])
xlim([-55 55])
```
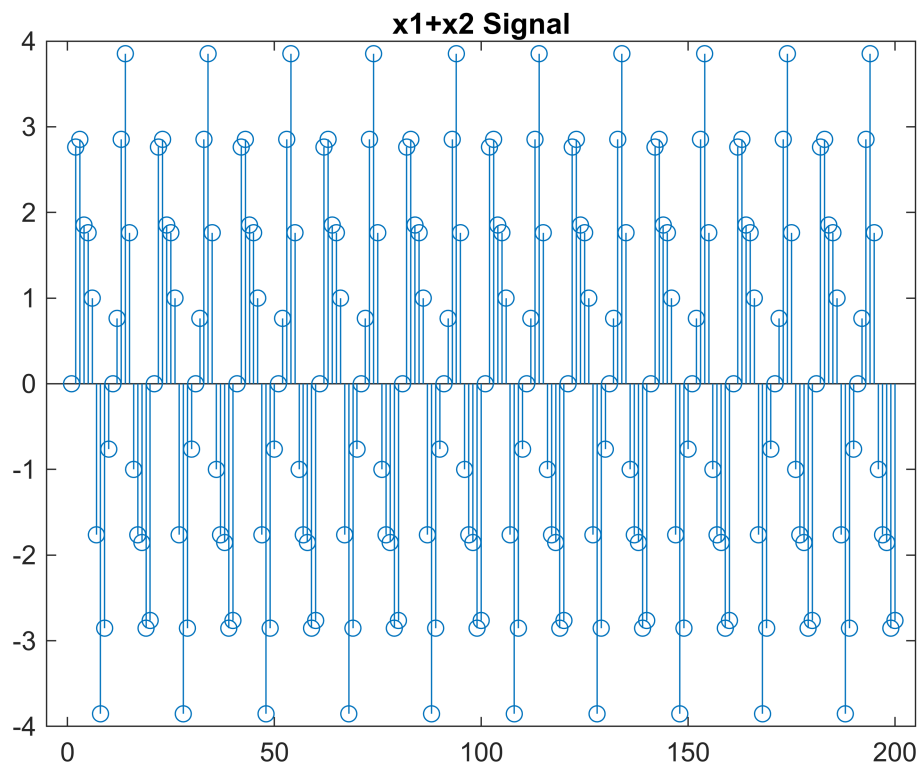
**x2 Frequency**

```
figure(4);
stem(x_2)
title('x2 Signal')
ylim([-3 3])
xlim([-5 205])
```
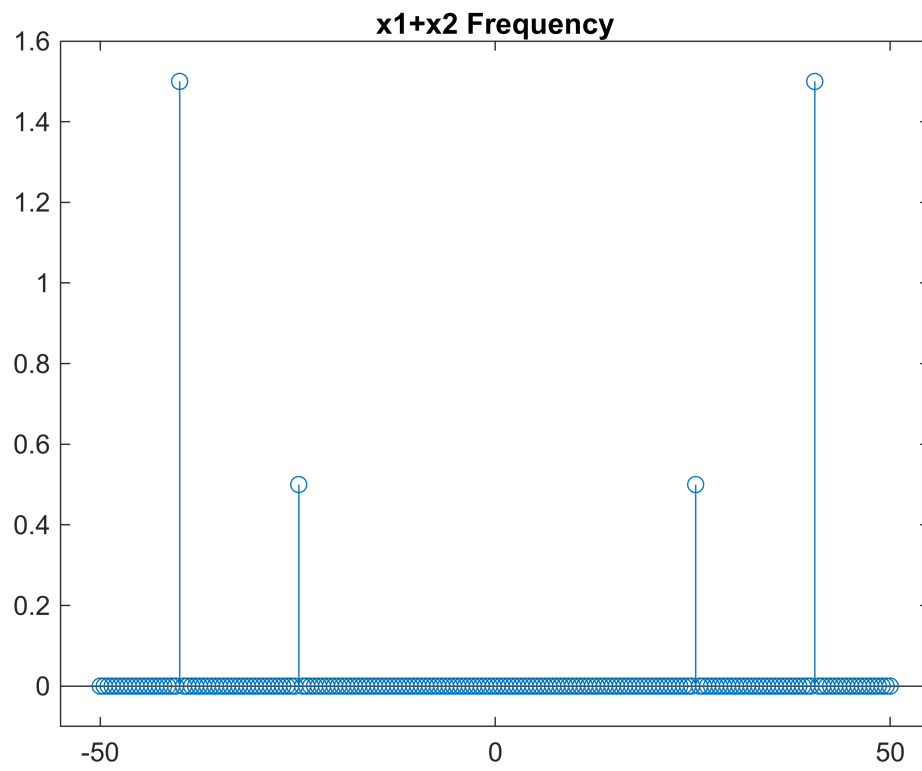
x2 Signal

```
x_toplam =x_1 + x_2;
f_axis_toplam = linspace(-F_s/2, F_s/2, length(x_toplam));
x_toplam_fft=fftshift(fft(x_toplam),length(x_toplam));

figure(5);
stem(x_toplam)
title('x1+x2 Signal')
ylim([-4 4])
xlim([-5 205])
```
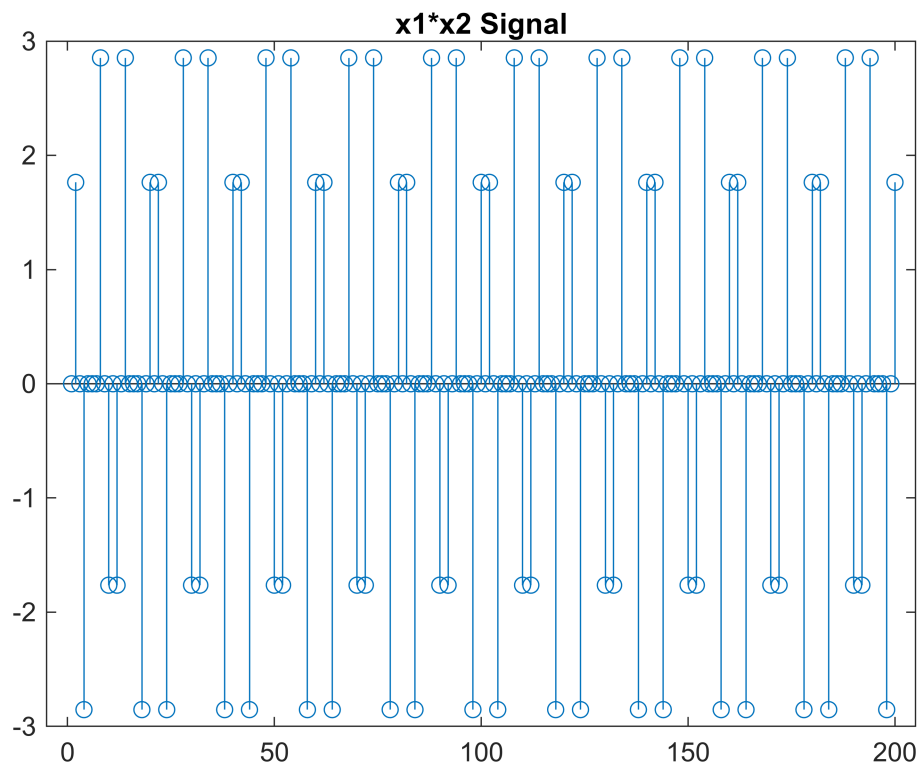
**x1+x2 Signal**

```
figure(6);
stem(f_axis_toplam,abs(x_toplam_fft)/length(x_toplam));
title('x1+x2 Frequency')
x_carpim =x_1 .* x_2;
f_axis_carpim = linspace(-F_s/2, F_s/2, length(x_carpim));
x_carpim_fft=fftshift(fft(x_carpim),length(x_carpim));
xlim([-55 55])
ylim([-0.1 1.6])
```

x1+x2 Frequency


```
figure(7);
stem(x_carpim)
title('x1*x2 Signal')
xlim([-5 205])
ylim([-3 3])
```

x1*x2 Signal

```
figure(8);
stem(f_axis_carpim,abs(x_carpim_fft)/length(x_carpim));
title('x1*x2 Frequency')
xlim([-55 55])
ylim([-0.1 0.8])
```
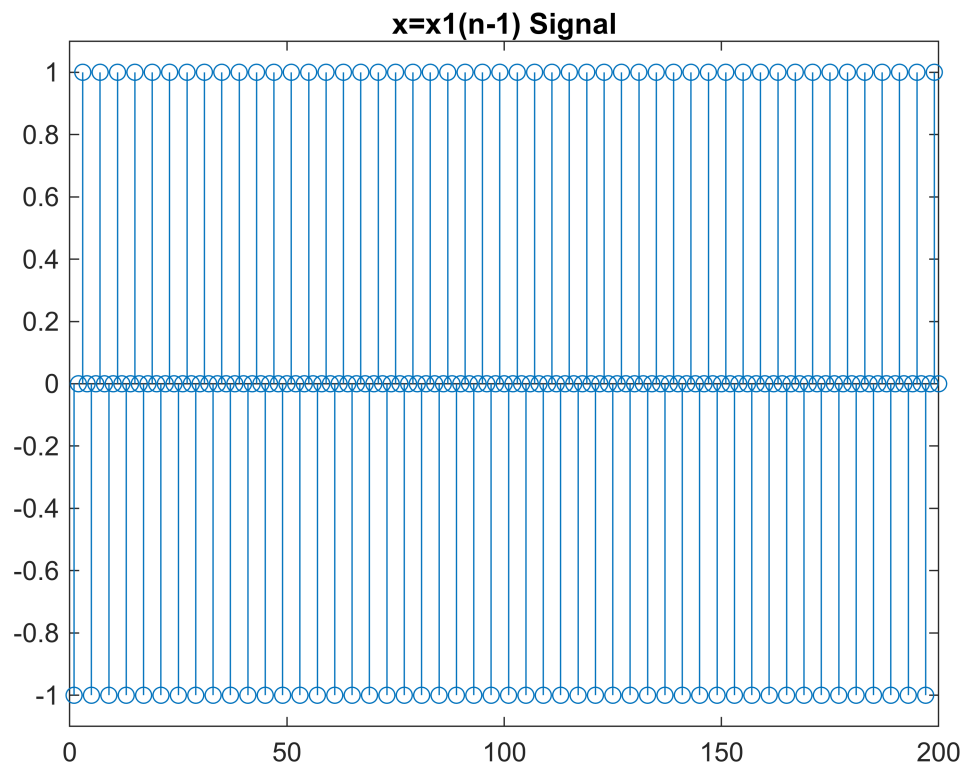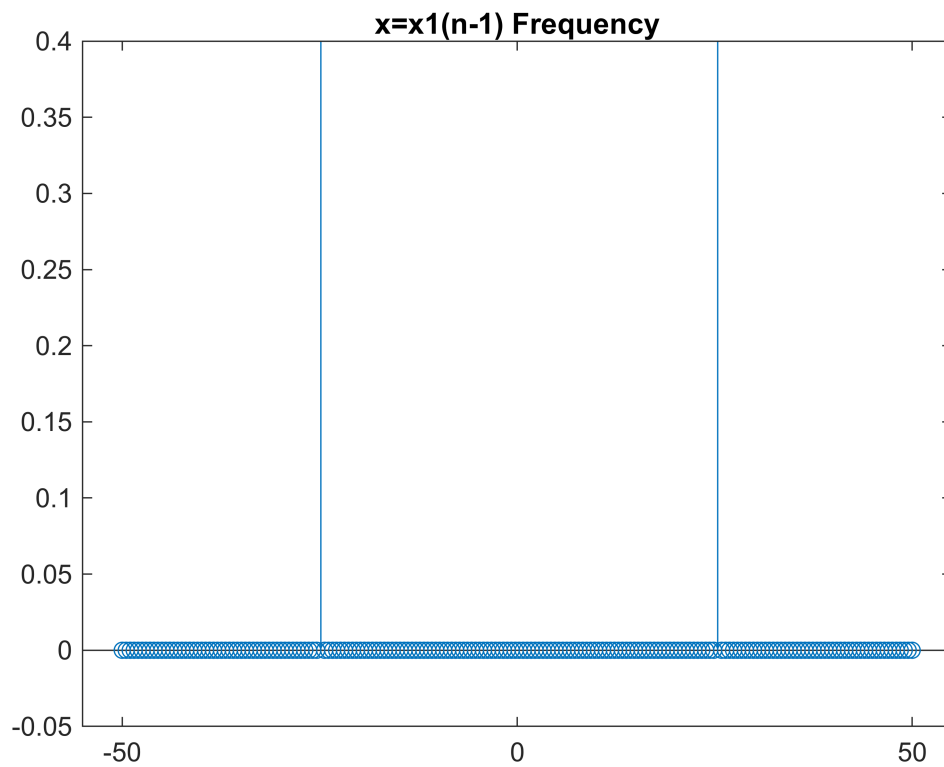
x1*x2 Frequency
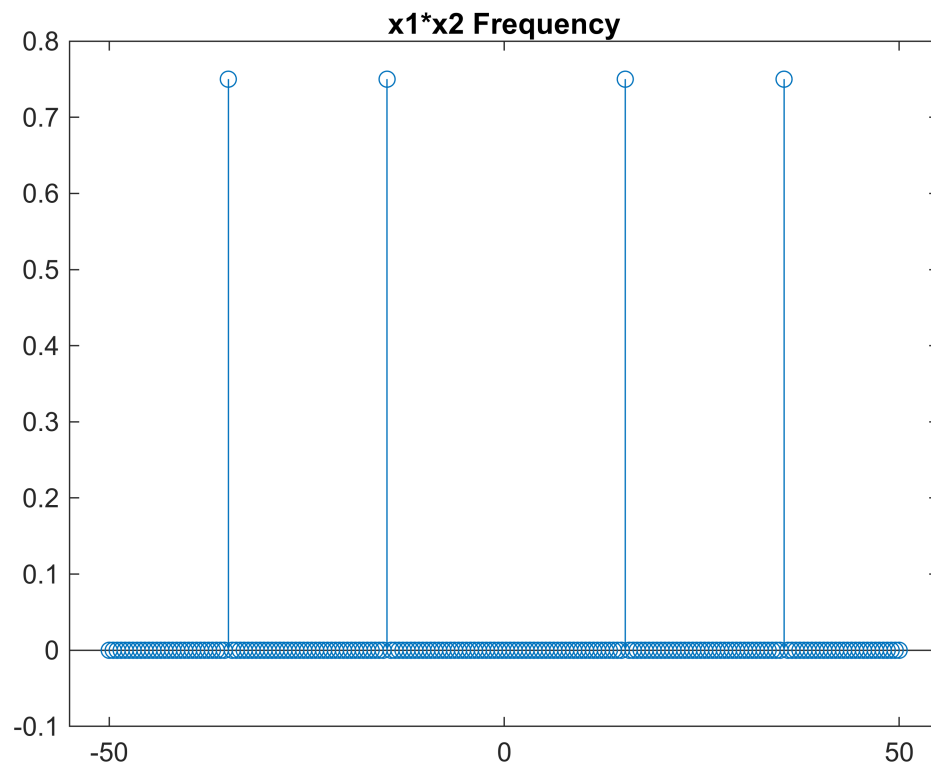
```matlab
A = 1;
f = 25;
T = 2;
F_s = 100;
x = gen(A, f, T, F_s);
for n=2:F_s*T
    x1(n)=x(n-1);
end
x1(1)=x(200);
f_axis_x1 = linspace(-F_s/2, F_s/2, length(x1));
x1_fft=fftshift(fft(x1),length(x1));

figure(9);
stem(x1)
title('x=x1(n-1) Signal')
xlim([0 200])
ylim([-1.1 1.1])
```

x=x1(n-1) Signal

```
figure(10);
stem(f_axis_x1,abs(x1_fft)/length(x1))
title('x=x1(n-1) Frequency')
xlim([-55 55])
ylim([-0.05 0.4])
```

9

x=x1(n-1) Frequency


```
[data, fs] = audioread('C:\starwars.wav');
Y = fft(data);
f = (-length(Y)/2:length(Y)/2-1)*(fs/length(Y));
Y_shifted = fftshift(Y);

t = (0:length(data)-1)/fs;
subplot(2,1,1);
plot(t, data);
title('Waveform of Starwars Audio');
xlabel('Time (s)');
ylabel('Amplitude');
xlim([0 3.1])
ylim([-0.8 0.8])

subplot(2,1,2);
plot(f, abs(Y_shifted)/max(abs(Y_shifted)));
title('Amplitude Spectrum');
xlabel('Frequency (Hz)');
ylabel('Amplitude');
xlim([-fs/2 fs/2])
ylim([0 1]);
```
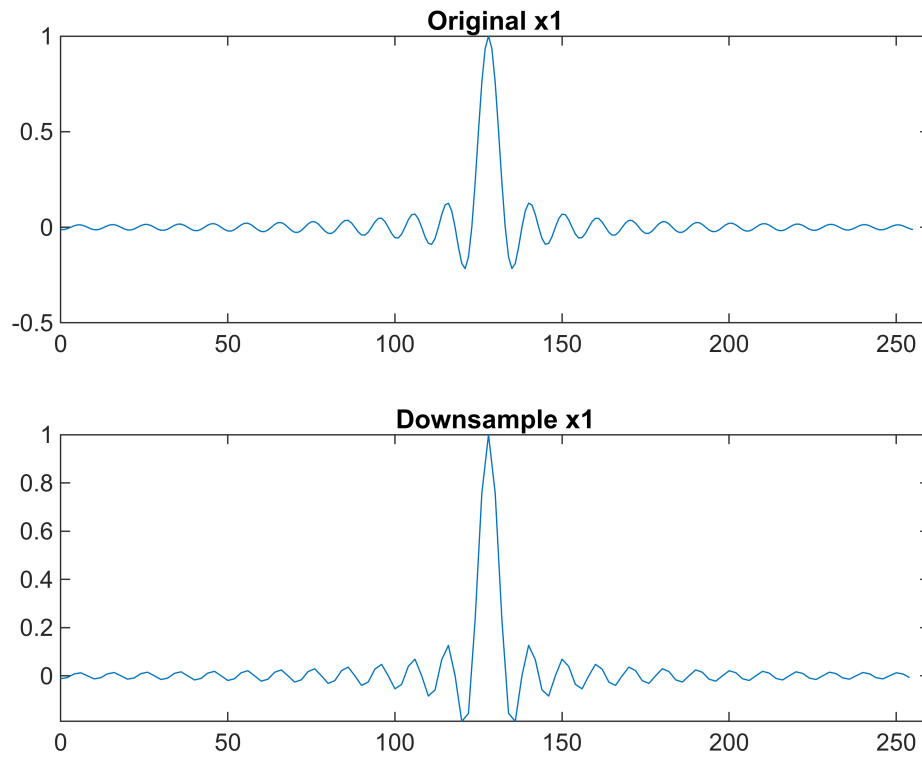
Waveform of Starwars Audio


Amplitude Spectrum
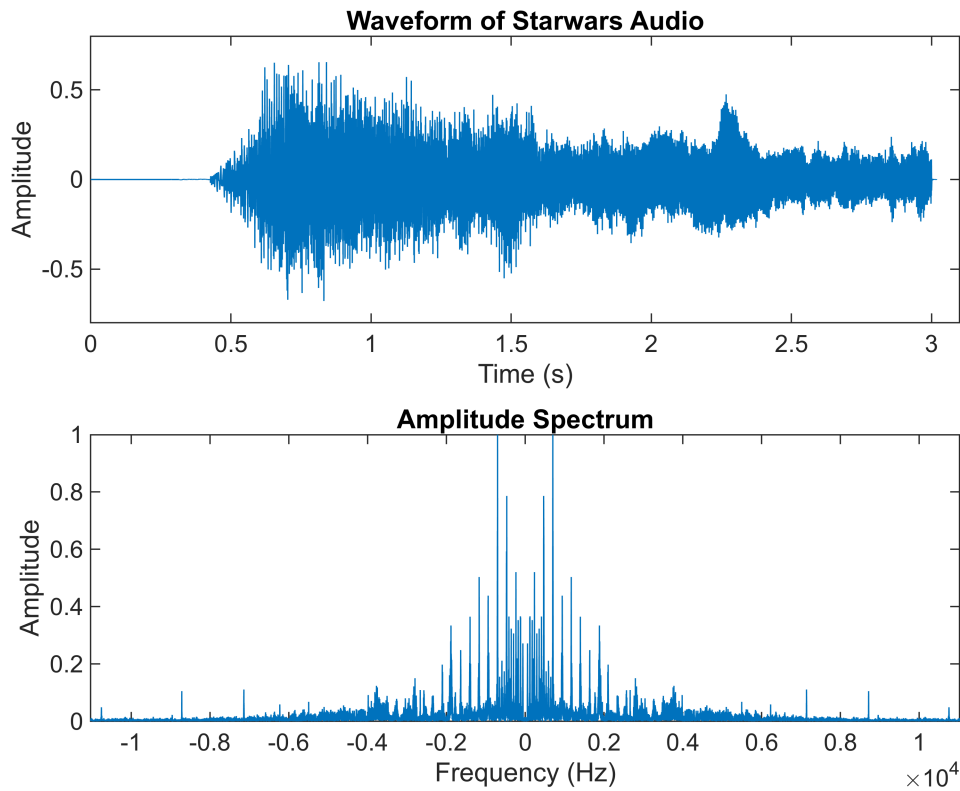

```
n=0:1:255;
x1=sinc(0.2*(n-128));
x2=sinc(0.8*(n-128));

xdown1 = downsample(x1, 2);
figure;
subplot(2,1,1);
plot(n, x1);
title('Original x1');
xlim([0 260])

subplot(2,1,2);
plot(n(1:2:end), xdown1);
title('Downsample x1');
xlim([0 260])
```
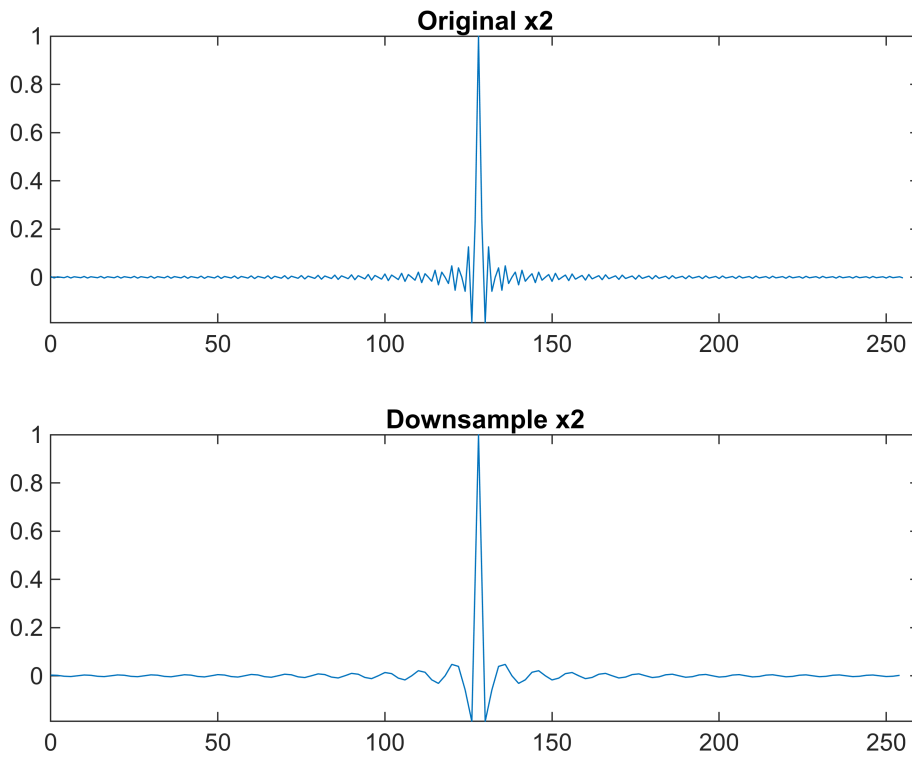
Original x1

Downsample x1


```matlab
xinterp1 = interp(xdown1, 2);
figure;
subplot(2,1,1);
plot(n, x1);
title('Original x1');
xlim([0 260])

subplot(2,1,2);
plot(n, xinterp1);
title('Interpolation x1');
xlim([0 260])
```

Original x1

Interpolation x1
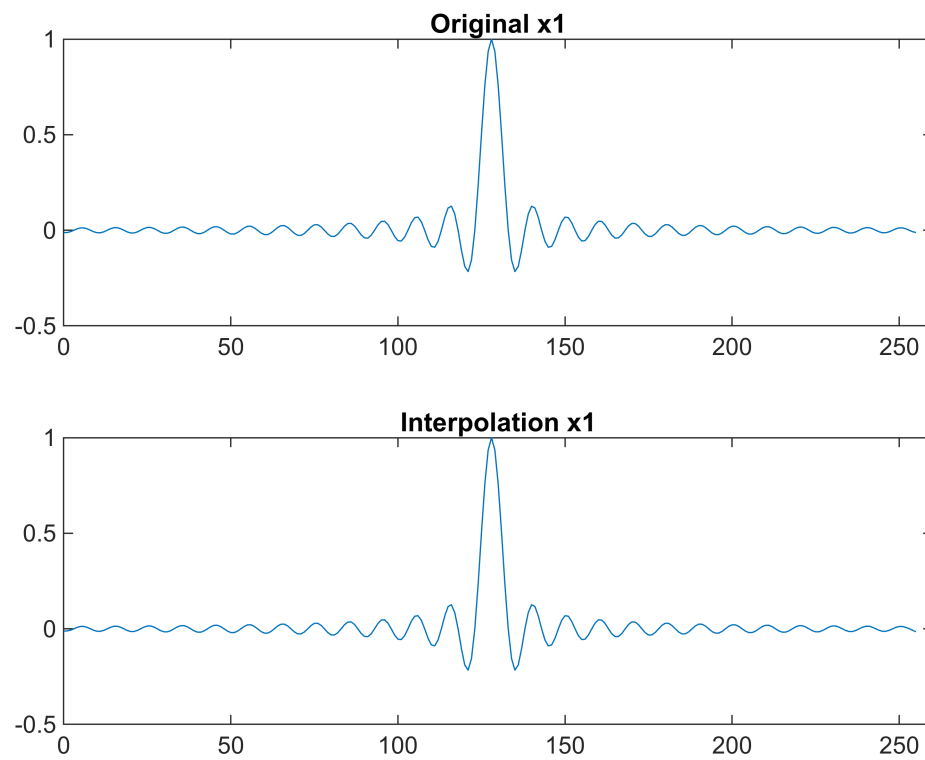
```
xdown2 = downsample(x2, 2);
figure;
subplot(2,1,1);
plot(n, x2);
title('Original x2');
xlim([0 260])

subplot(2,1,2);
plot(n(1:2:end), xdown2);
title('Downsample x2');
xlim([0 260])
```

Original x2

Downsample x2


```matlab
xinterp2 = interp(xdown2, 2);
figure;
subplot(2,1,1);
plot(n, x2);
title('Original x2');
xlim([0 260])

subplot(2,1,2);
plot(n, xinterp2);
title('Interpolation x2');
xlim([0 260])
```

Original x2

Interpolation x2
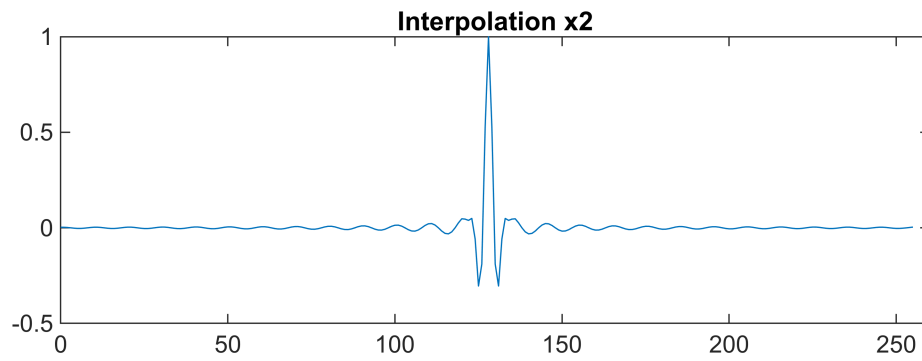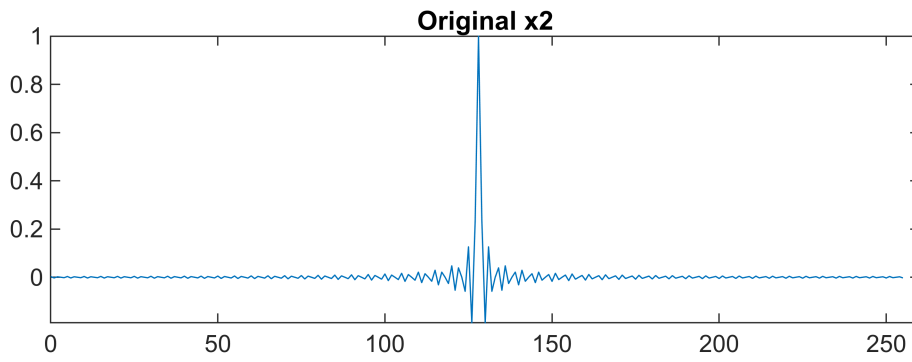
```matlab
function x = gen(A, f, T, F_s)
    n = 0:T*F_s - 1;
    x = A * sin(2*pi*f*n/F_s);
end
```