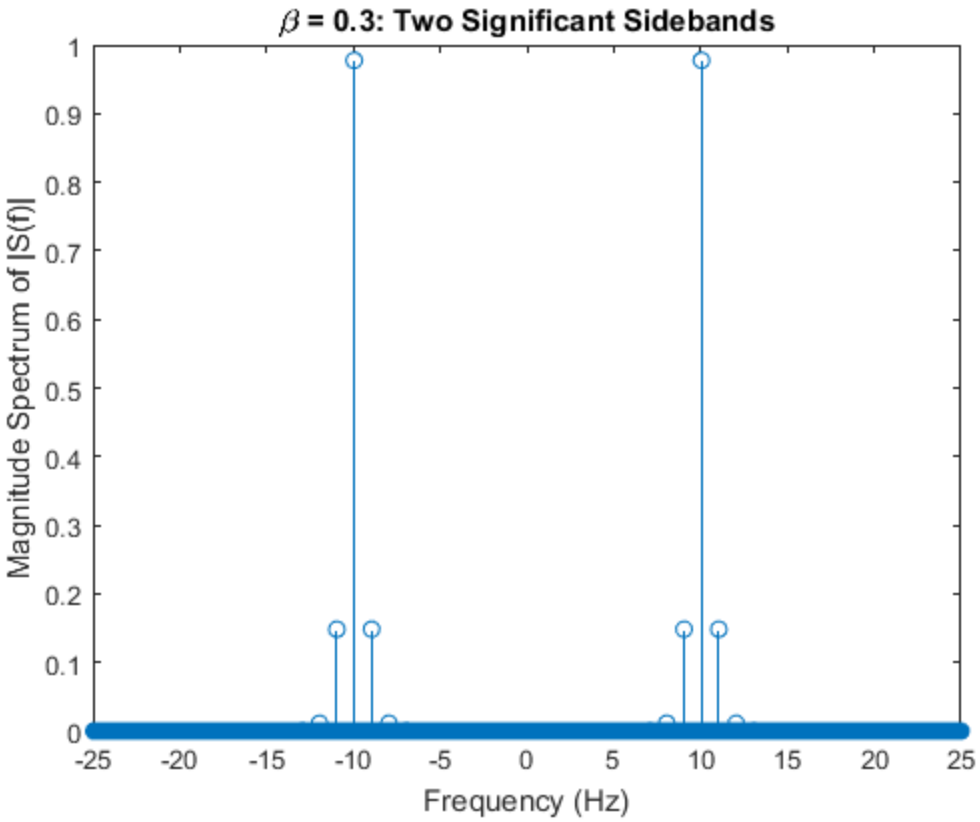
```
% Joseph Palicke
% Lab 6 Pt 2

n    = -499:500;                                    % Establishing 1000
 points
Ts   = 0.02;                                        % Sample period
t    = n * Ts;                                      % Time scaling
kf   = 0.2;                                         % Frequency
 sensitivity
fm   = 1;                                           % Message frequency
Am   = 1.5;                                         % Message amplitude
m    = Am*cos(2*pi*fm*t);                           % Message with unit
 frequency
fc   = 10;                                          % Carrier Frequency 10
 Hz
Ac   = 2;                                           % Carrier Amplitude
s = Ac*cos(2*pi*fc*t+(kf*Am/fm)*sin(2*pi*fm*t));% FM waveform
delf = 1/(Ts*1000);                                 % Separation of
 frequencies
f    = n*delf;                                      % Frequency scaling
sft  = abs(fft(s))/1000;                            % Spectrum magnitude
figure(1);
stem(f,fftshift(sft));
xlabel('Frequency (Hz)')
ylabel('Magnitude Spectrum of |S(f)|')
title('\beta = 0.3: Two Significant Sidebands')

n    = -499:500;                                    % Establishing 1000
 points
Ts   = 0.02;                                        % Sample period
t    = n * Ts;                                      % Time scaling
kf   = 0.2;                                         % Frequency
 sensitivity
fm   = 1;                                           % Message frequency
Am   = 5;                                         % Message amplitude
m    = Am*cos(2*pi*fm*t);                           % Message with unit
 frequency
fc   = 10;                                          % Carrier Frequency 10
 Hz
Ac   = 2;                                           % Carrier Amplitude
s = Ac*cos(2*pi*fc*t+(kf*Am/fm)*sin(2*pi*fm*t));% FM waveform
delf = 1/(Ts*1000);                                 % Separation of
 frequencies
f    = n*delf;                                      % Frequency scaling
sft  = abs(fft(s))/1000;                            % Spectrum magnitude
figure(2);
stem(f,fftshift(sft));
xlabel('Frequency (Hz)')
ylabel('Magnitude Spectrum of |S(f)|')
title('\beta = 1: Six Significant Sidebands fm = 1')
```

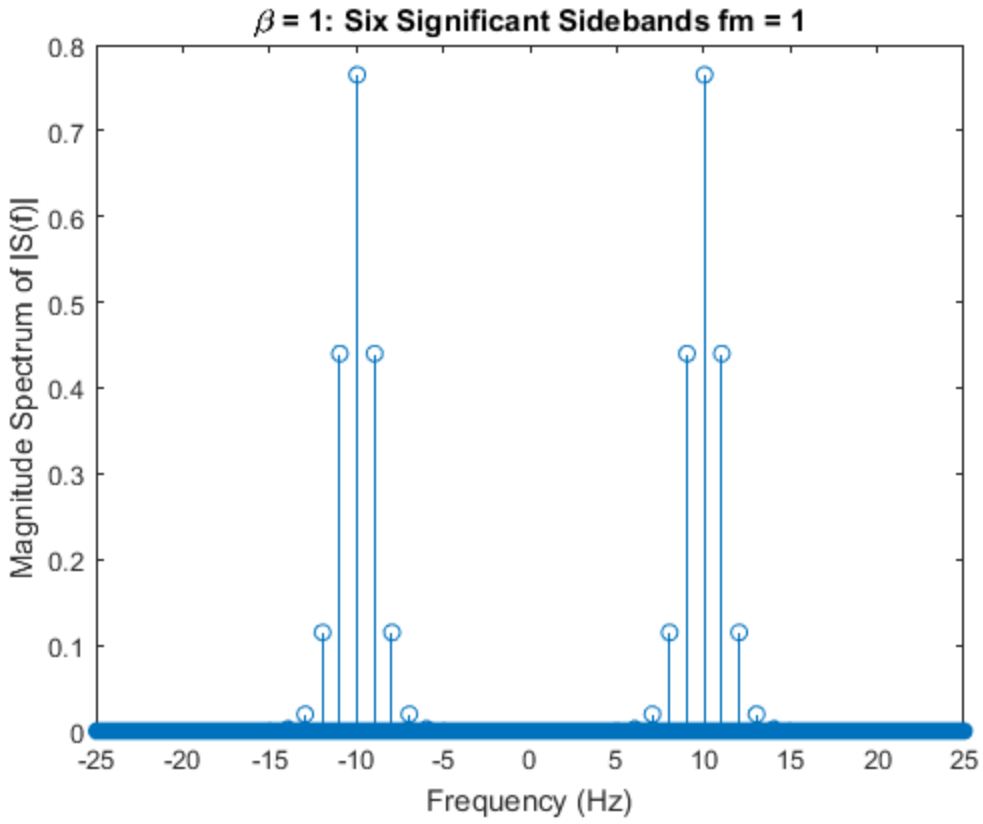
```
n    = -499:500;                                    % Establishing 1000
 points
Ts   = 0.02;                                        % Sample period
t    = n * Ts;                                      % Time scaling
kf   = 0.2;                                         % Frequency
 sensitivity
fm   = 1;                                           % Message frequency
Am   = 10;                                         % Message amplitude
m    = Am*cos(2*pi*fm*t);                           % Message with unit
 frequency
fc   = 10;                                          % Carrier Frequency 10
 Hz
Ac   = 2;                                           % Carrier Amplitude
s = Ac*cos(2*pi*fc*t+(kf*Am/fm)*sin(2*pi*fm*t));% FM waveform
delf = 1/(Ts*1000);                                 % Separation of
 frequencies
f    = n*delf;                                      % Frequency scaling
sft  = abs(fft(s))/1000;                            % Spectrum magnitude
figure(3);
stem(f,fftshift(sft));
xlabel('Frequency (Hz)')
ylabel('Magnitude Spectrum of |S(f)|')
title('\beta = 2: Eight Significant Sidebands fm = 1')

n    = -499:500;                                    % Establishing 1000
 points
Ts   = 0.02;                                        % Sample period
t    = n * Ts;                                      % Time scaling
kf   = 0.2;                                         % Frequency
 sensitivity
fm   = 1;                                           % Message frequency
Am   = 5;                                          % Message amplitude
m    = Am*cos(2*pi*fm*t);                           % Message with unit
 frequency
fc   = 10;                                          % Carrier Frequency 10
 Hz
Ac   = 2;                                           % Carrier Amplitude
s = Ac*cos(2*pi*fc*t+(kf*Am/fm)*sin(2*pi*fm*t));% FM waveform
delf = 1/(Ts*1000);                                 % Separation of
 frequencies
f    = n*delf;                                      % Frequency scaling
sft  = abs(fft(s))/1000;                            % Spectrum magnitude
figure(4);
stem(f,fftshift(sft));
xlabel('Frequency (Hz)')
ylabel('Magnitude Spectrum of |S(f)|')
title('\beta = 5: Sixteen Significant Sidebands fm = 1')

n    = -499:500;                                    % Establishing 1000
 points
Ts   = 0.02;                                        % Sample period
t    = n * Ts;                                      % Time scaling
kf   = 0.5;                                         % Frequency
 sensitivity
```

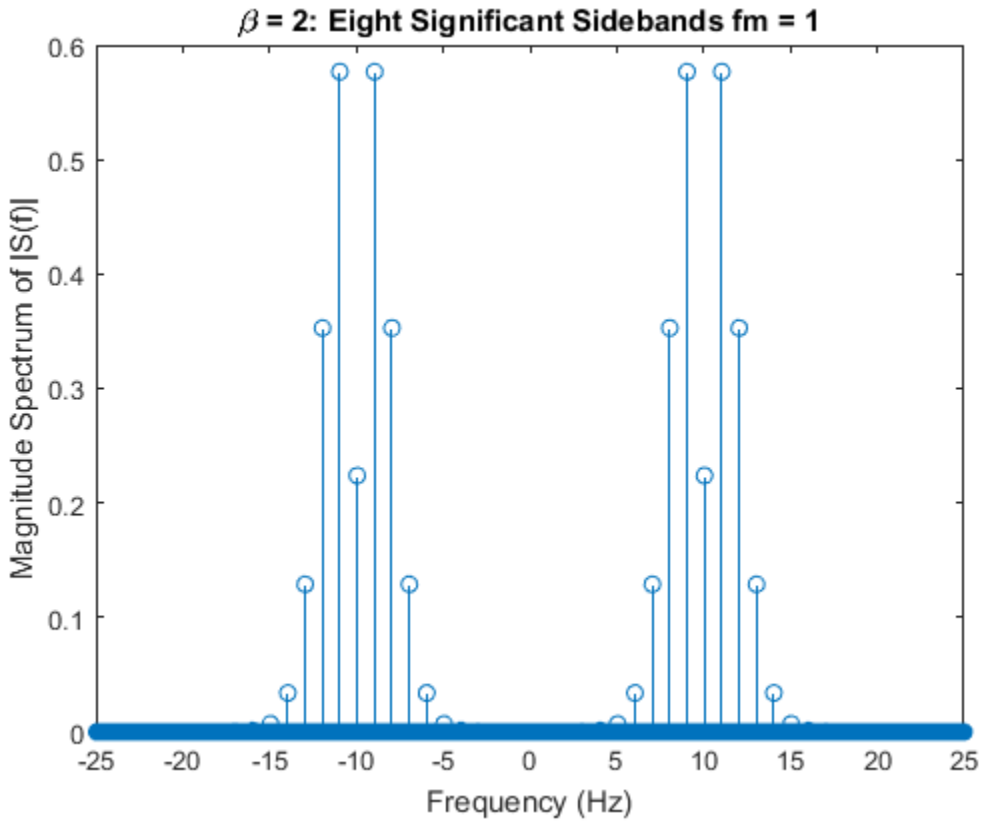
```
fm   = 1;                                          % Message frequency
Am   = 2.5;                                        % Message amplitude
m    = Am*cos(2*pi*fm*t);                          % Message with unit
 frequency
fc   = 10;                                         % Carrier Frequency 10
 Hz
Ac   = 2;                                          % Carrier Amplitude
s = Ac*cos(2*pi*fc*t+(kf*Am/fm)*sin(2*pi*fm*t));% FM waveform
delf = 1/(Ts*1000);                                % Separation of
 frequencies
f    = n*delf;                                     % Frequency scaling
sft  = abs(fft(s))/1000;                           % Spectrum magnitude
figure(5);
stem(f,fftshift(sft));
xlabel('Frequency (Hz)')
ylabel('Magnitude Spectrum of |S(f)|')
title('\beta = 1: Six Significant Sidebands fm = 0.5')

n    = -499:500;                                   % Establishing 1000
 points
Ts   = 0.02;                                       % Sample period
t    = n * Ts;                                     % Time scaling
kf   = 0.2;                                        % Frequency
 sensitivity
fm   = 0.5;                                          % Message frequency
Am   = 5;                                        % Message amplitude
m    = Am*cos(2*pi*fm*t);                          % Message with unit
 frequency
fc   = 10;                                         % Carrier Frequency 10
 Hz
Ac   = 2;                                          % Carrier Amplitude
s = Ac*cos(2*pi*fc*t+(kf*Am/fm)*sin(2*pi*fm*t));% FM waveform
delf = 1/(Ts*1000);                                % Separation of
 frequencies
f    = n*delf;                                     % Frequency scaling
sft  = abs(fft(s))/1000;                           % Spectrum magnitude
figure(6);
stem(f,fftshift(sft));
xlabel('Frequency (Hz)')
ylabel('Magnitude Spectrum of |S(f)|')
title('\beta = 2: Eight Significant Sidebands fm = 0.5')

n    = -499:500;                                   % Establishing 1000
 points
Ts   = 0.02;                                       % Sample period
t    = n * Ts;                                     % Time scaling
kf   = 0.2;                                        % Frequency
 sensitivity
fm   = 0.5;                                          % Message frequency
Am   = 12.5;                                       % Message amplitude
m    = Am*cos(2*pi*fm*t);                          % Message with unit
 frequency
fc   = 10;                                         % Carrier Frequency 10
 Hz
```

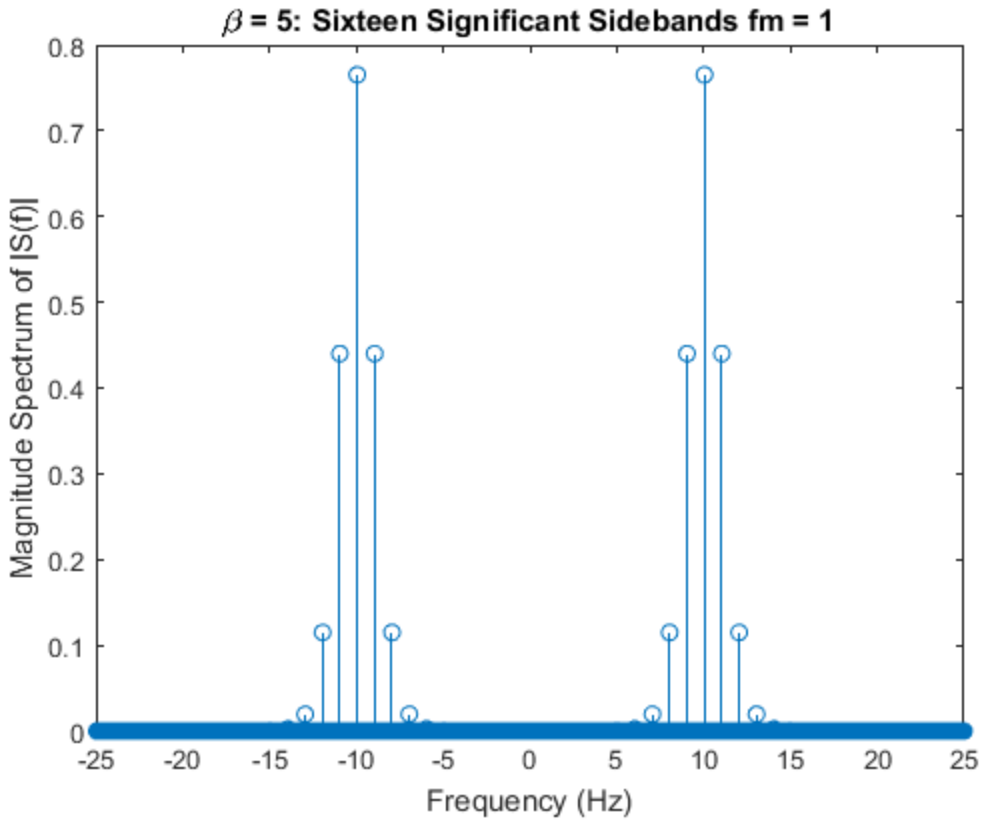
```
Ac   = 2;                                          % Carrier Amplitude
s = Ac*cos(2*pi*fc*t+(kf*Am/fm)*sin(2*pi*fm*t));% FM waveform
delf = 1/(Ts*1000);                                % Separation of
 frequencies
f    = n*delf;                                     % Frequency scaling
sft  = abs(fft(s))/1000;                           % Spectrum magnitude
figure(7);
stem(f,fftshift(sft));
xlabel('Frequency (Hz)')
ylabel('Magnitude Spectrum of |S(f)|')
title('\beta = 5: Sixteen Significant Sidebands fm = 0.5')

n    = -499:500;                                   % Establishing 1000
 points
Ts   = 0.02;                                       % Sample period
t    = n * Ts;                                     % Time scaling
kf   = 0.2;                                        % Frequency
 sensitivity
fm   = 1;                                          % Message frequency
Am   = 12.024;                                        % Message amplitude
m    = Am*cos(2*pi*fm*t);                          % Message with unit
 frequency
fc   = 10;                                         % Carrier Frequency 10
 Hz
Ac   = 2;                                          % Carrier Amplitude
s = Ac*cos(2*pi*fc*t+(kf*Am/fm)*sin(2*pi*fm*t));% FM waveform
delf = 1/(Ts*1000);                                % Separation of
 frequencies
f    = n*delf;                                     % Frequency scaling
sft  = abs(fft(s))/1000;                           % Spectrum magnitude
figure(8);
stem(f,fftshift(sft));
xlabel('Frequency (Hz)')
ylabel('Magnitude Spectrum of |S(f)|')
title('\beta = 2.4048: Eight Significant Sidebands fm = 1')

n    = -499:500;                                   % Establishing 1000
 points
Ts   = 0.02;                                       % Sample period
t    = n * Ts;                                     % Time scaling
kf   = 0.2;                                        % Frequency
 sensitivity
fm   = 0.5;                                          % Message frequency
Am   = 6.012;                                        % Message amplitude
m    = Am*cos(2*pi*fm*t);                          % Message with unit
 frequency
fc   = 10;                                         % Carrier Frequency 10
 Hz
Ac   = 2;                                          % Carrier Amplitude
s = Ac*cos(2*pi*fc*t+(kf*Am/fm)*sin(2*pi*fm*t));% FM waveform
delf = 1/(Ts*1000);                                % Separation of
 frequencies
f    = n*delf;                                     % Frequency scaling
sft  = abs(fft(s))/1000;                           % Spectrum magnitude
```

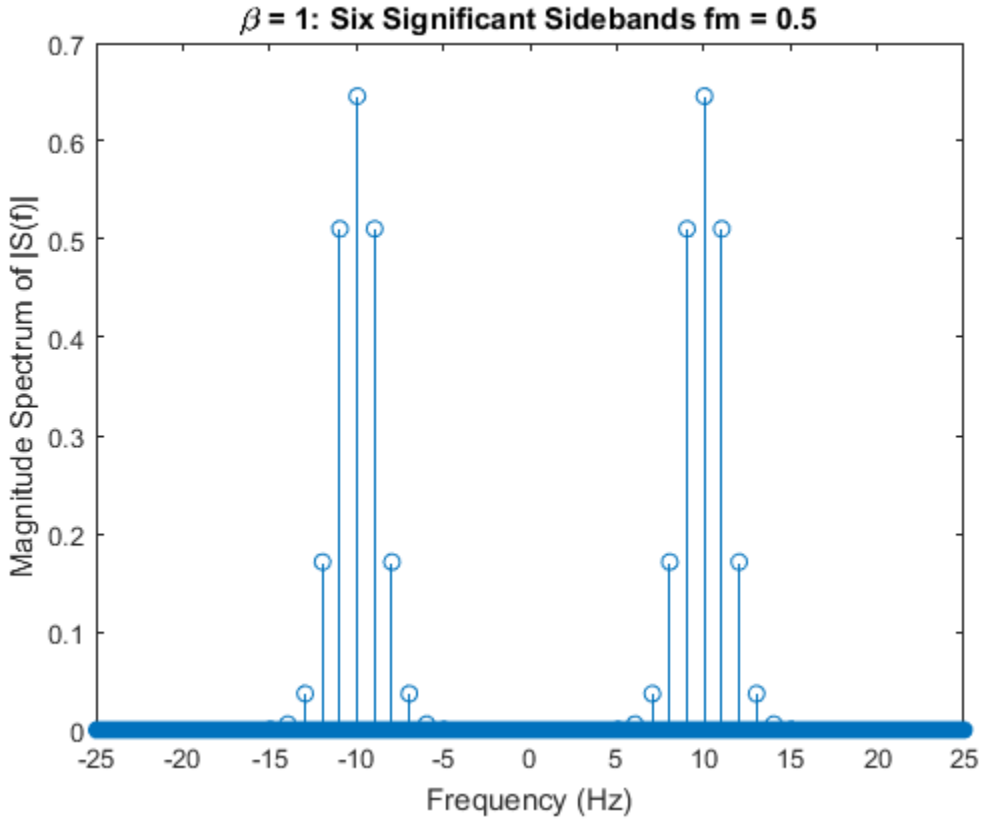
```
figure(9);
stem(f,fftshift(sft));
xlabel('Frequency (Hz)')
ylabel('Magnitude Spectrum of |S(f)|')
title('\beta = 2.4048: Eight Significant Sidebands fm = 0.5')
```

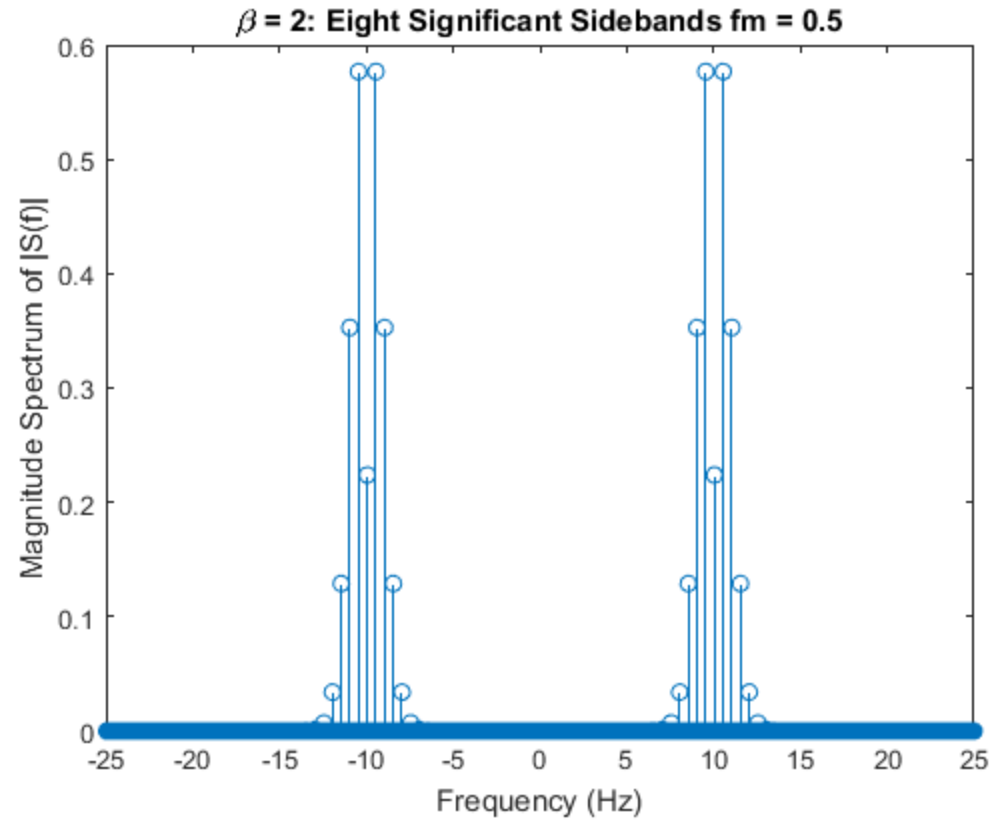


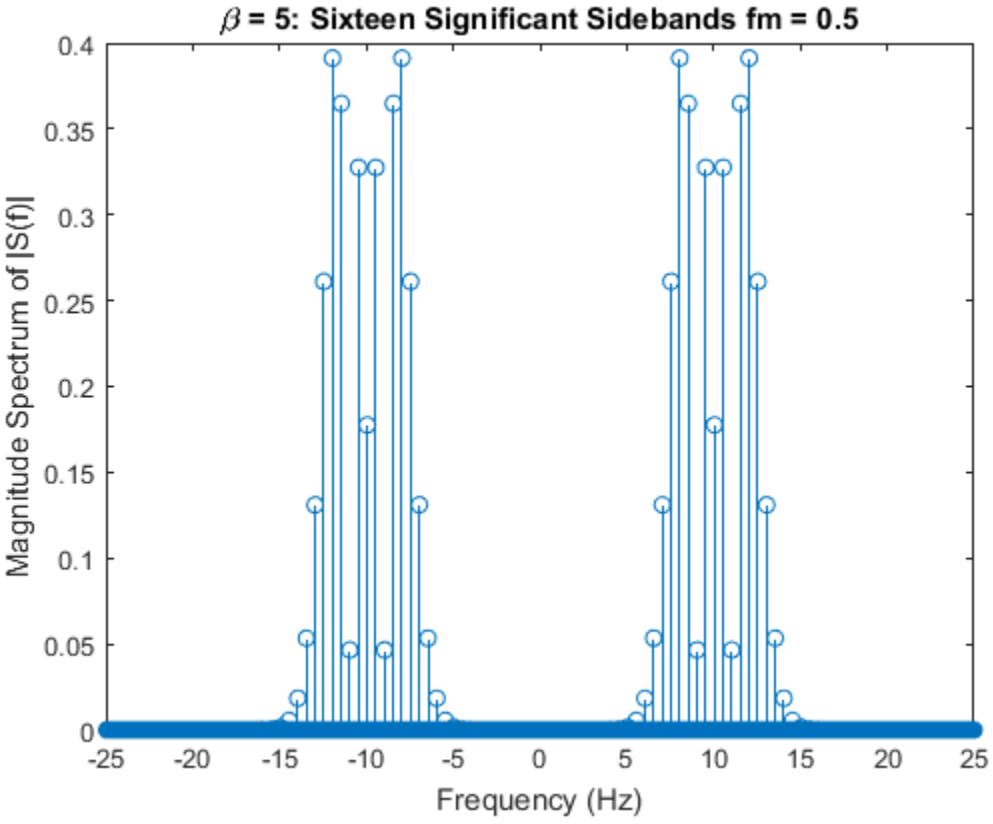

β = 1: Six Significant Sidebands fm = 1
Magnitude Spectrum of |S(f)|
Frequency (Hz)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-25
-20
-15
-10
-5
0
5
10
15
20
25

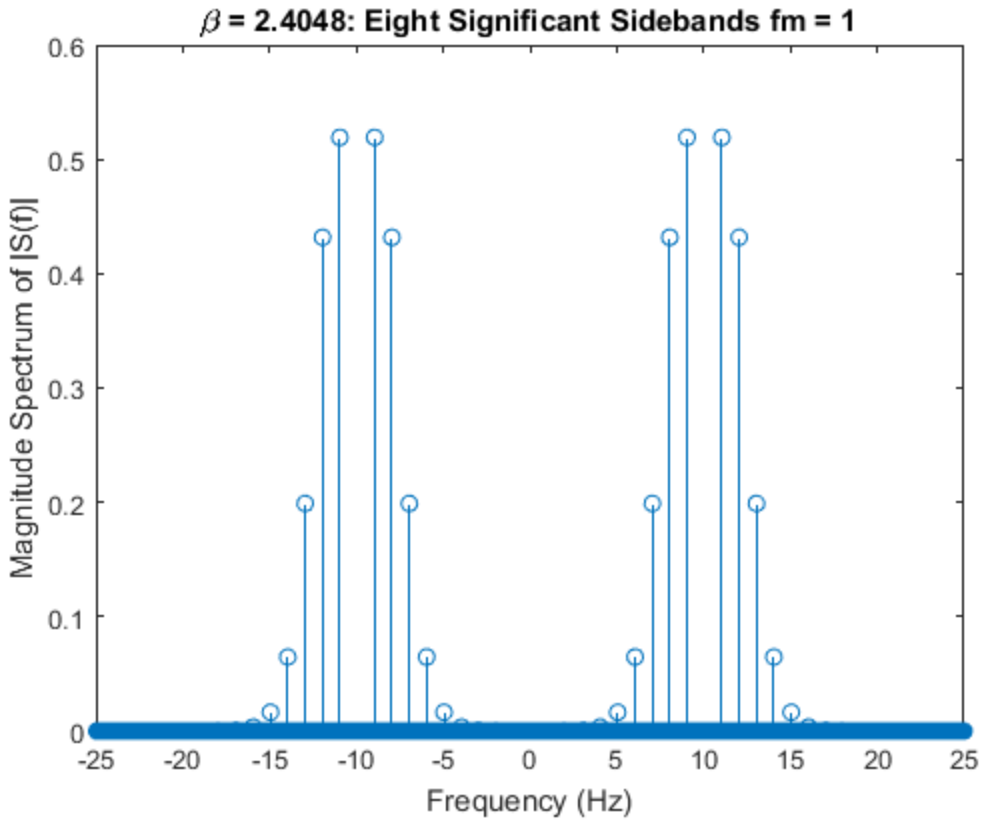

β = 2: Eight Significant Sidebands fm = 1
Magnitude Spectrum of |S(f)|
Frequency (Hz)
0.6
0.5
0.4
0.3
0.2
0.1
0
-25
-20
-15
-10
-5
0
5
10
15
20
25

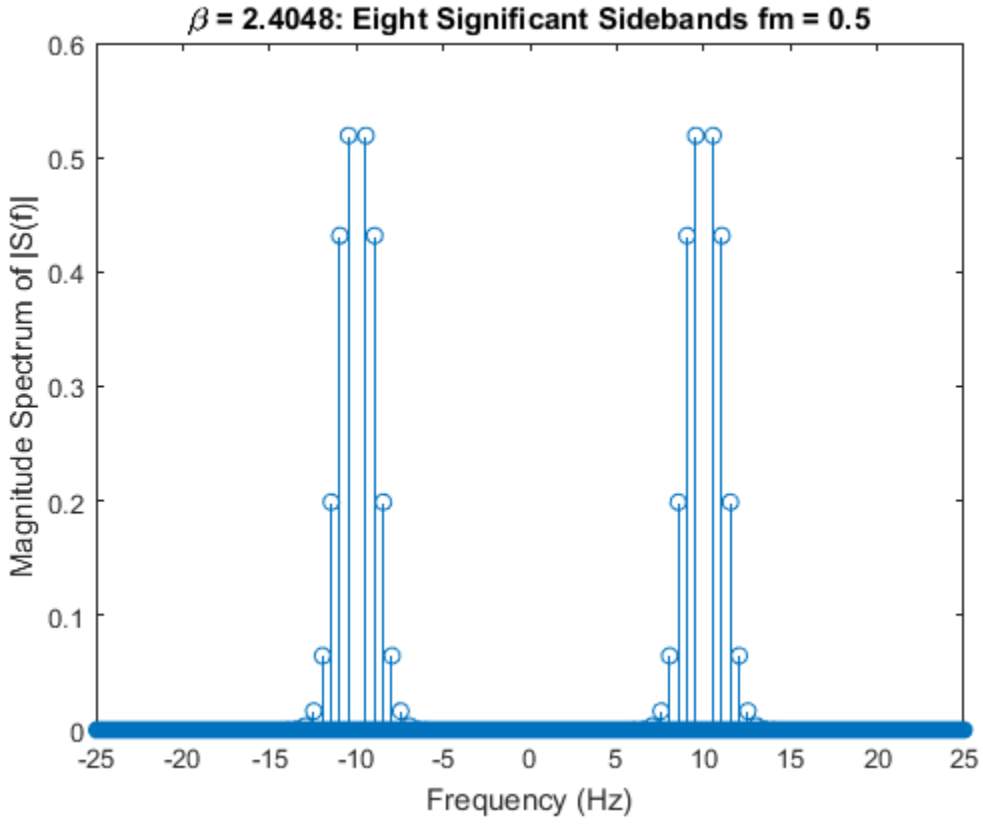

β = 5: Sixteen Significant Sidebands fm = 1
Magnitude Spectrum of |S(f)|
Frequency (Hz)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
-25
-20
-15
-10
-5
0
5
10
15
20
25


β = 1: Six Significant Sidebands fm = 0.5
Magnitude Spectrum of |S(f)|
Frequency (Hz)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
-25
-20
-15
-10
-5
0
5
10
15
20
25


β = 2: Eight Significant Sidebands fm = 0.5
Magnitude Spectrum of |S(f)|
Frequency (Hz)
0.6
0.5
0.4
0.3
0.2
0.1
0
-25
-20
-15
-10
-5
0
5
10
15
20
25


β = 5: Sixteen Significant Sidebands fm = 0.5
Magnitude Spectrum of |S(f)|
Frequency (Hz)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-25
-20
-15
-10
-5
0
5
10
15
20
25


β = 2.4048: Eight Significant Sidebands fm = 1
Magnitude Spectrum of |S(f)|
Frequency (Hz)
0.6
0.5
0.4
0.3
0.2
0.1
0
-25
-20
-15
-10
-5
0
5
10
15
20
25


β = 2.4048: Eight Significant Sidebands fm = 0.5
Magnitude Spectrum of |S(f)|
Frequency (Hz)
0.6
0.5
0.4
0.3
0.2
0.1
0
-25
-20
-15
-10
-5
0
5
10
15
20
25

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