6.31 Write a MATLAB script that uses function *f_firsamp* to design a linear-phase bandpass FIR filter of order $m = 40$ using the frequency sampling method. Use a sampling frequency of $f_s = 200$ Hz, and a passband of $F_p = [20, 60]$ Hz. Use *f_freqz* to compute and plot the linear magnitude response. Add the frequency samples using a separate plot symbol and a legend. Do the following cases.

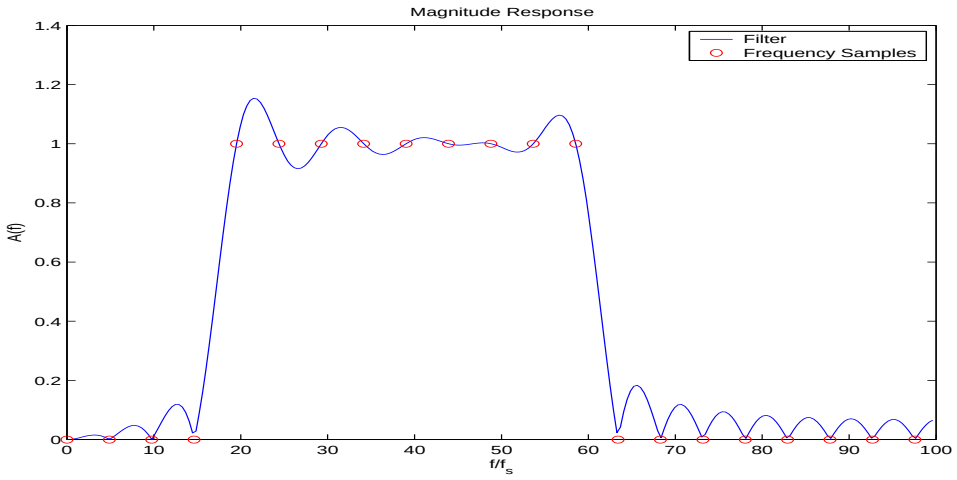
(a) No transition band samples (ideal amplitude response)

(b) One transition band sample of amplitude 0.5 on each side of the passband.

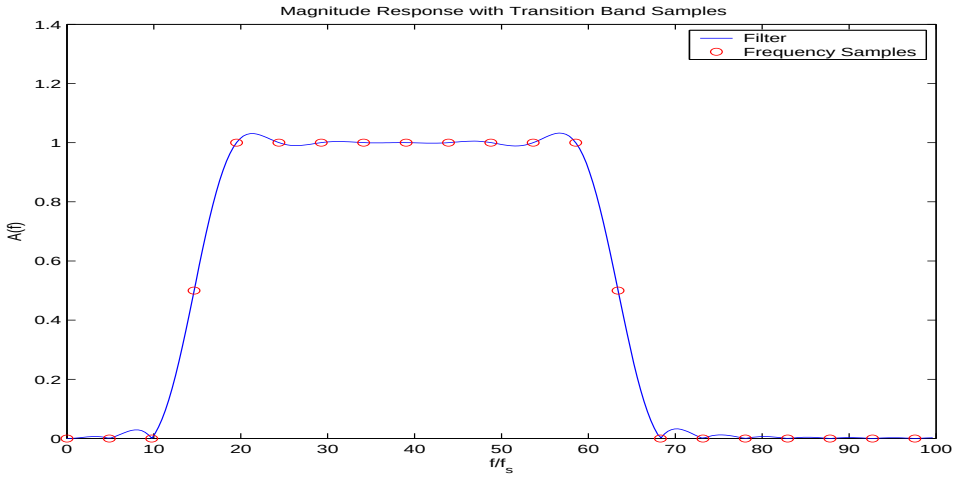
Solution

```
% Problem 6.31

% Initialize

clear
clc
fs = 200;
F_p = [20,60];
m = 40;

% Construct samples of amplitude response

N = m+1;
i = 0 : m/2;
fi = i*fs/N;
m1 = (F_p(1)/fs)*m+1;
m2 = (F_p(2)/fs)*m+1;
Ai = zeros(size(i));
for k = m1 : m2
    Ai(k) = 1;
end

% Design filter

sym = 0;
b = f_firsamp (Ai,m,fs,sym);
a = 1;
p = 256;
[H,f] = f_freqz (b,a,p,fs);
A1 = abs(H);
figure
plot (f,A1,fi,Ai,'ro');
f_labels ('Magnitude Response','f/f_s','A(f)')
legend ('Filter','Frequency Samples')
f_wait
```

```
% Add transition band samples

Ai(m1-1) = 0.5;
Ai(m2+1) = 0.5;
b = f_firsamp(Ai,m,fs,sym);
[H,f] = f_freqz (b,a,p,fs);
A2 = abs(H);
figure
plot (f,A2,fi,Ai,'ro');
f_labels ('Magnitude Response with Transition Band Samples','f/f_s','A(f)')
legend ('Filter','Frequency Samples')
f_wait
```



Frequency-Sampled Bandpass Filter, No Transition Band Samples



Frequency-Sampled Bandpass Filter, Transition Band Samples