Problem 2

In this problem, you are given a file **q2.mat** with signal X and the sampling frequency, **Fs**. The signal consists of the sound played by a particular key of a two tone telephone. Your task is to find out the frequencies of this particular key, and clean the noisy signal as best as you can.

Approach

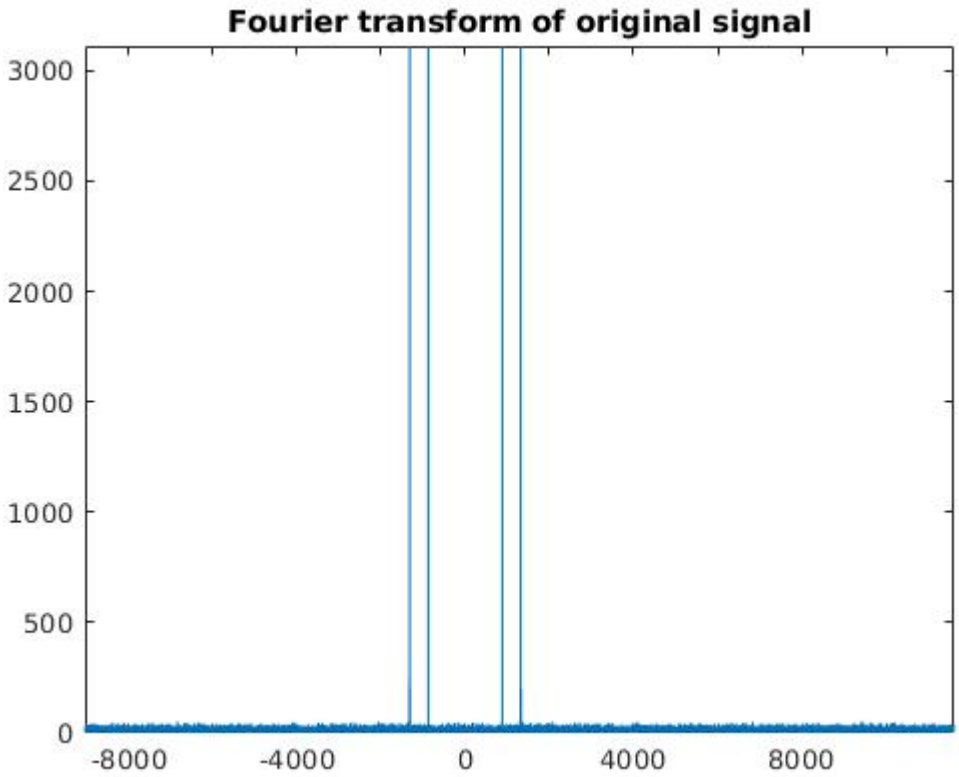
- First we load **q2.mat** and find out the **signal X** and **frequency Fs**.
- Then we convert the signal to frequency domain using `fft` and `fftshift` functions.
- We find out the frequencies present in the dial tone of that key by plotting graph of FFT.
- Then we made a band pass filter whose value is 1 never the peaks of FFT and is 0 elsewhere.
- We mutiply the original signal by our filter, to get denoised signal, the converted the signal back to time domain using `ifft` and `ifftshift` functions.

Code

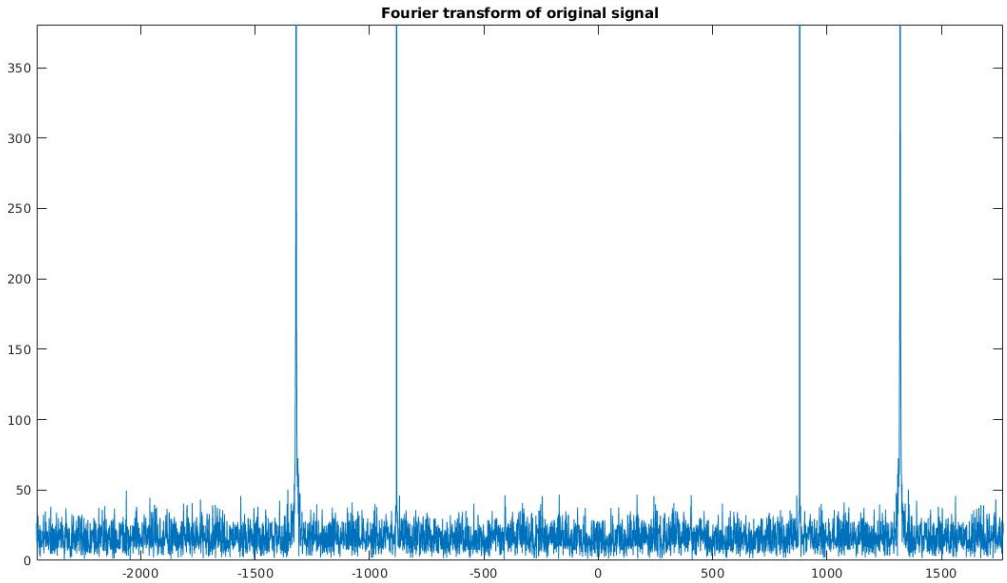
1. Finding the input signal, converting to frequency domain and plotting the FFT.

```
% Getting X, Fs
aud = load('q2.mat');
X = aud.X;
Fs = aud.Fs;

% Doing Fourier Transform
Y = fftshift(fft(X));
l = length(Y);
P1 = abs(Y);
f =  (-l/2:l/2 -1);
figure;
plot(f,P1);
title('Fourier transform of original signal');
```



In the above figure ,we can clearly see the noise in the input signal.



From the above figure, we can get the frequencies of this particular key,

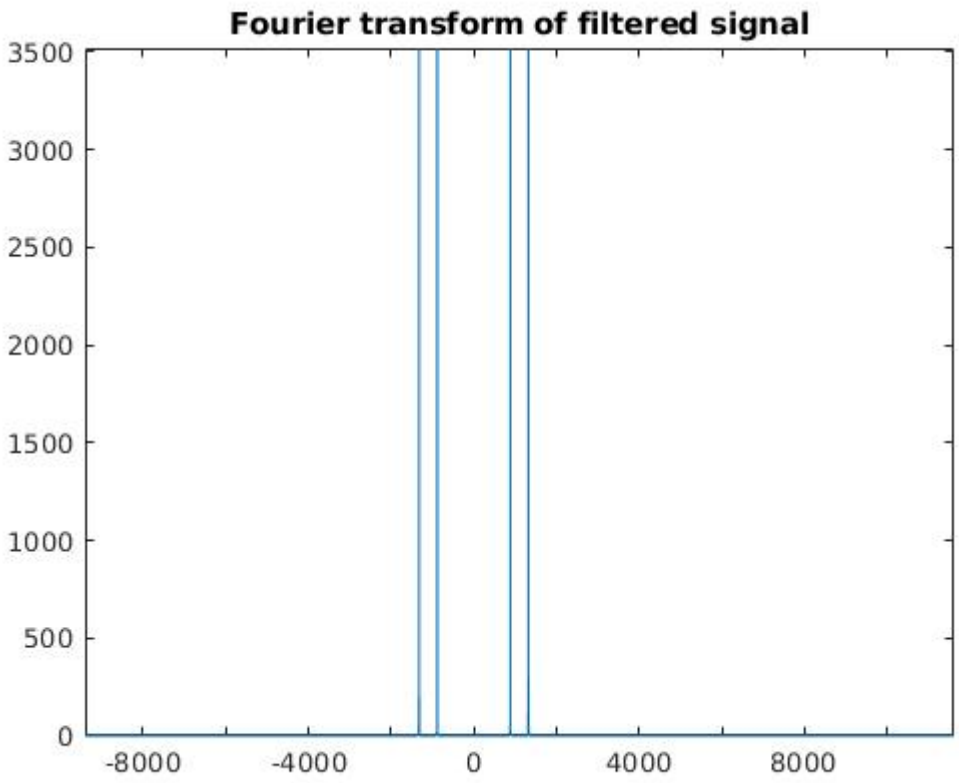
2. Applying the filter

```
% Figure out the X values for filtering from the plot
f1 = 885;
f2 = 1325;
r = 10;

% Making band pass filter
rectangle = zeros(l,1);
```

```
rectangle(l/2 + f1 -r:l/2 + f1 +r) = 1;
rectangle(l/2 + f2 -r:l/2 + f2 +r) = 1;
rectangle(l/2 - f1 -r:l/2 - f1 +r) = 1;
rectangle(l/2 - f2 -r:l/2 - f2 +r) = 1;

% Multiplying the fft of original signal by filter
Y1 = Y.*rectangle;
P2 = abs(Y1);
figure;
plot(f,P2);
title('Fourier transform of filtered signal');
```



In the above figure ,we can clearly see that there is no noise in this signal.

3. Taking inverse fourier transform to take reconstructed signal back into time domain.

```
% Performing Ifft of filtered signal
y_rect = ifft(ifftshift(Y1));
sound(y_rect,Fs);
```