Classwork-6 Due: 7^{th} July, 2015

Note: When being asked to design/create a filter, you have to at least include its frequency response.

Problem 1:

Let the sampling frequency Fs be 8 kHz, and the time vector t runs from 0 to 50 ms. Create a signal $y(t) = \cos(2\pi f_1 t) + \cos(2\pi f_2 t)$ where $f_1 = 1209\ Hz$ and $f_2 = 1336\ Hz$

a) Plot $y(t)$ in both time and frequency domain.
b) Design a low-pass filter to filter out f_2, and then apply this filter to $y(t)$. Plot the result in both time and frequency domain.
c) Design a high-pass filter to filter out f_1, and then apply this filter to $y(t)$. Plot the result in both time and frequency domain.
d) Design a band-pass filter to pass f_1 while reject f_2, and then apply this filter to $y(t)$. Plot the result in both time and frequency domain.

Problem 2:

The sampling rate of the ECG signal we had from classwork-2 is 512Hz. Each impulse is one beat. The normal heart rate is between 50 and 100 beats per minute at rest

a) Plot the signal versus time domain. Estimate the heart rate from the signal.
b) Plot the frequency spectrum of the signal.
c) Baseline Wander removal: Given that the baseline wander is usually in the range below 0.5Hz in case the patients' movements are not large. Design a high pass filter to remove those low frequency components. Apply the filter you have just designed onto the ECG signal and plot the result.

Problem 3:

In classwork-2, we already applied a low-pass filter to the ECG signal (using the Matlab's *'filter'* function). That filter has the difference equation:

$$y(n) = \frac{x(n) + x(n-1) + x(n-2)}{3}$$

Plot the frequency response of this filter; adjust your axis properly and put a marker to show the cut-off frequency. Estimate its cut-off frequency in Hz given that the sampling frequency is 512 Hz.