## 6.1 Preliminaries

In this section, the low-pass filter (LPF) is designed. Firstly, you can choose the sampling frequency as **50kHz** and the time duration as **0-10ms** to set the simulation environments. Then, you consider a signal that consists of two sinusoidal with different frequencies such that one has **8kHz** and the other one has **24kHz**. Finally, we can separate these signals via the LPF to obtain lower frequency sinusoidal.

You may use the following codes for LPF;

```
>> freqs = [0 0.4 0.45 1];
>> amps =  [1 1 0 0];
>> b = firpm(100,freqs,amps);
>> y = filter(b,1,x);
```

where **x** is the generated signal by yours and **y** is the filtered signal. You can observe the frequency response of these signals by using the Fourier Transform and observe the filter response using `>> freqz(b)` command. You can also find basic knowledge about above built-in functions by simply writing `>> help firpm` and `>> help filter` on the command window in MatLab. Before you start the lab experiment, you had better answer the following questions;

1- What is the value of normalized frequency that corresponds to 1 in *freqs* for the above code?

2- How do we choose these normalized frequencies in the *freqs*?

3- What is the value of cutoff frequency for the LPF in the normalized frequency domain?

4- If we want to design a high-pass filter (HPF) to obtain higher frequency sinusoidal from $x$, how can *amps* and/or *freqs* be changed?

## 6.2 Filtering LabWork

(a) Set the sampling frequency as **1kHz** and the time duration as **0-0.5s**.

(b) Generate the below signal;

$$x(t) = sin(200\pi t) + 2sin(400\pi t) + 0.5sin(600\pi t)$$

(c) Design LPF, HPF and band-pass (BPF) to filter for the lowest frequency, for the highest frequency and for the middle frequency components in *x(t)*, respectively. Note that you have to use *firpm()* command to obtain these filters as in preliminaries, otherwise you will not get any credit.

(d) Plot the frequency response of each designed filter.

(e) Plot the *x(t)* and filtered signals which are obtained from (c) and their frequency domain representations in a single figure by using **subplot(42x)** where x indicates the order of each plot.

(f) Design the ideal filters that includes LPF, HPF and BPF as obtained from (c) and plot them into another figure by using *subplot()* command.