Experiment 2

Signals and Systems Representation

Objectives:

After this experiment the student should be able to

1. Perform Fourier transform for common signals.
2. Recognize the different types of filters.

Introduction :

A signal is a function that symbolizes a physical variable of interest. Signals can be represented in time or frequency domains. The two representations are related by Fourier Transformation.

The Fourier transform for the signal g(t) can be defined as:

$$\mathbf{G(f)}=\int_{-\infty}^{\infty} g(t)e^{-j2\pi f} \text{...(1)}$$

The Table 1 shows the Fourier transform for common signal that needed in this course:

Signal g(t)	Fourier transform G(f)
A Cos(2πfot)	$\frac{A}{2}$ [δ(f- fo) + δ(f+ fo)]
A sin(2πfot)	$\frac{A}{2J}$ [δ(f- fo) - δ(f+ fo)]
m(t) Cos(2πfot)	$\frac{A}{2}$ [M(f- fo) + M(f+fo)]
A rect (t/T)	AT Sinc(Tf)

Filters:

In the communication system it is necessary separate a specific range of frequencies from the total frequency spectrum, this is normally accomplished with filters. A filter is a circuit that pass specific range of frequency while reject other frequencies.

There are four basic types of filters as shown in figure :

1. **Low Pass Filter:** designed to pass all frequencies below the cut off frequency while reject all frequencies above the cut off.

2. **High Pass Filter (LPF) :**designed to pass all frequencies above the cut off frequency while reject all frequencies below the cut off.

3. **Band Pass Filter (BPF):** designed to pass all frequencies within a specific band of frequencies and reject all frequencies outside of that band.

4. **Band Stop Filter (BSF):** designed to reject all frequencies within a specific band of frequencies and pass all frequencies outside of that band.

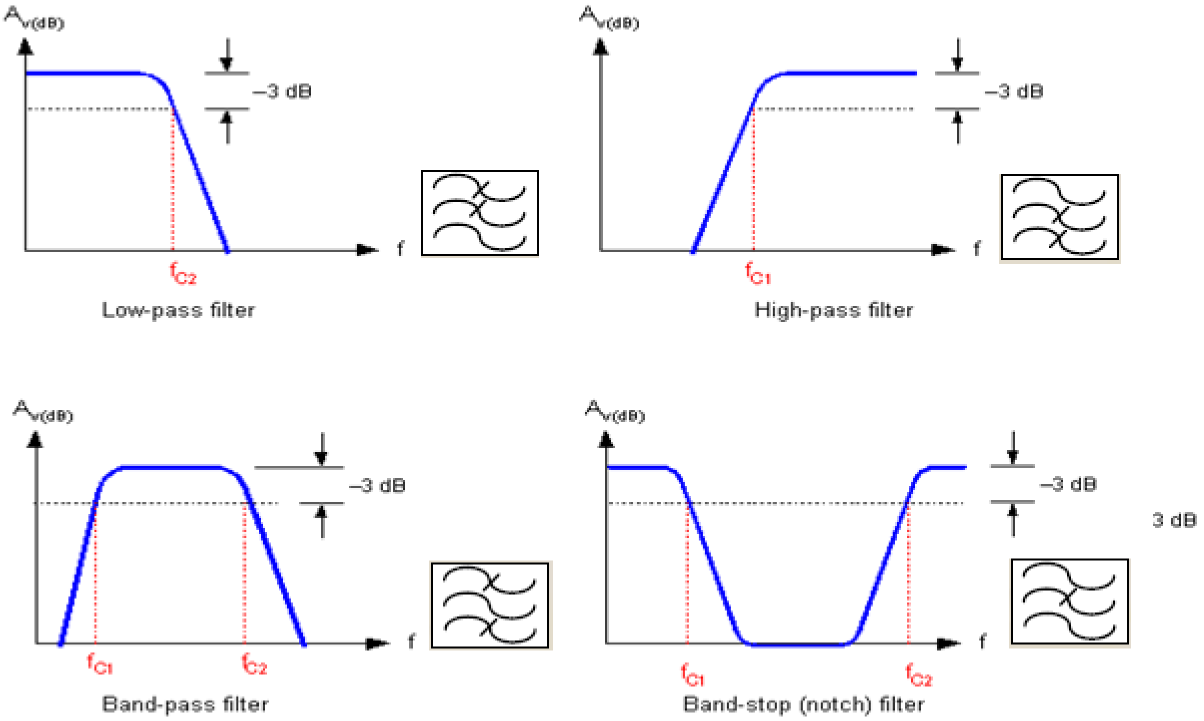


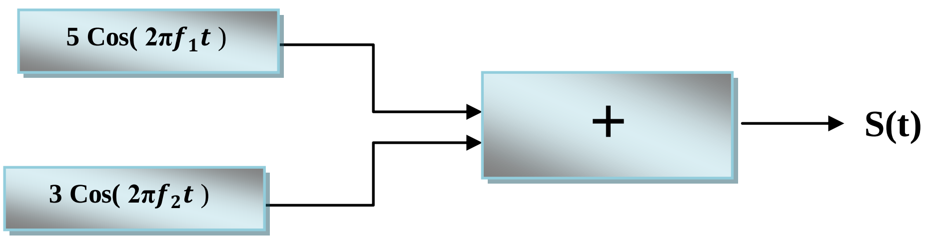
Figure1. Filter types

Lab Work :

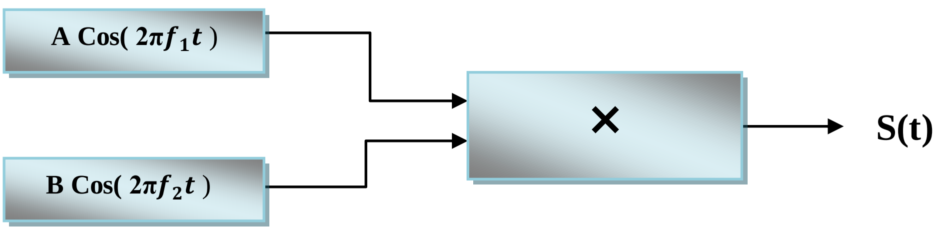
There is only one part in this experiment. we will verify some of Fourier transform and study the effect of filtering on the signals:

Procedure:

1. Using frequency counter ,set the Audio Oscillator frequency to 5kHz Sinusoidal signal.
2. Using PicoScope (Spectrum Mode) Plot the signal spectrum in your lab sheet and compare it with theoretical expectation.
3. Repeat point 2 for 2kHz TTL from Master signals
4. Select and connect the proper modules to implement the following block diagram Where: f_1=2kHz, f_2=10kHz.



5. Obtain the plot of S(t) from both the spectrum analyzer and the Oscilloscope and compare with your theoretical expectations. Comment on the noise level and harmonics.
6. Select and connect the proper modules to implement the following block diagram Where: f_1=2kHz, f_2=10kHz



7. Obtain the plot of S(t) from both the spectrum analyzer and the Oscilloscope and compare with your theoretical expectations. Comment on the noise level and harmonics.
8. Connect the output of the multiplier to the input of Tunable
9. Turn the Tune knob to minimum (full counter clockwise).
10. Observing the output, gradually increase the cutoff frequency to allow one harmonic, then two harmonics, write the cutoff frequency for each harmonic in you lab sheet.
11. Explain the effect of the filter cutoff frequency on the output waveform.