Cairo University

Faculty of Engineering

B.Sc. Program-Credit Hours system

CCE-E

ELCN306: Communications-1

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Level: Senior-1

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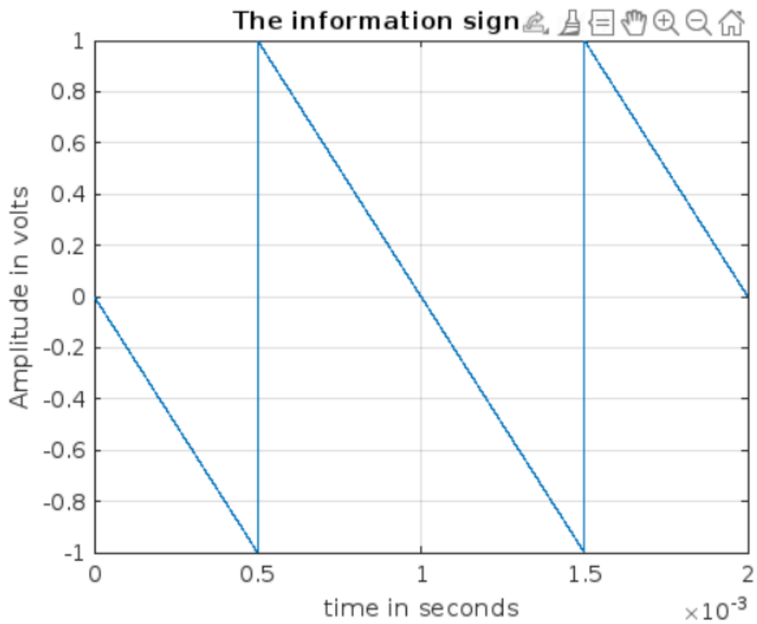
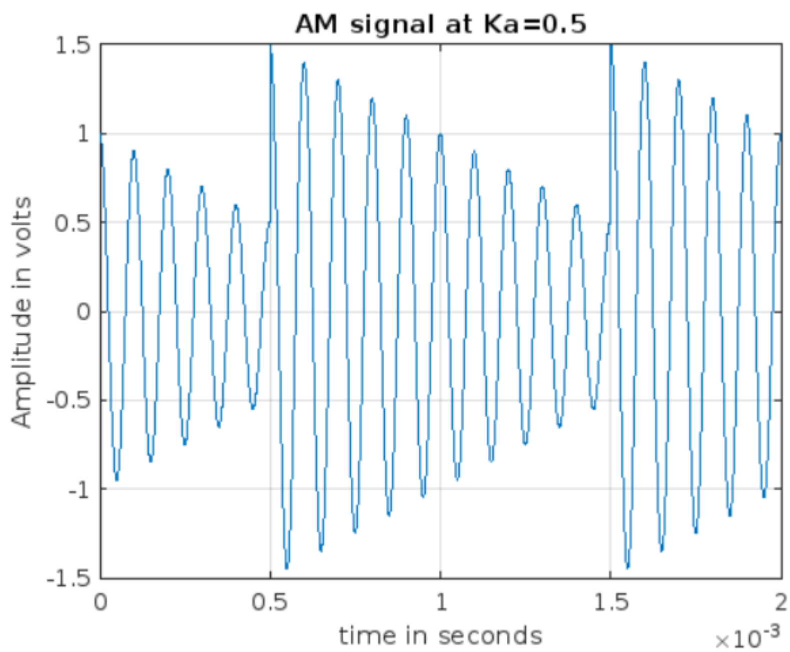
Project - Part II

I) DSB-LC

1. Generate an input modulating signal $m(t)$ shown in Fig. 1.



2. Generate an AM DSB-LC signal with $m(t)$ using a carrier wave $c(t)$of 1 Volt amplitude and 10 KHz frequency Ka = 0.5. Comment on the result.

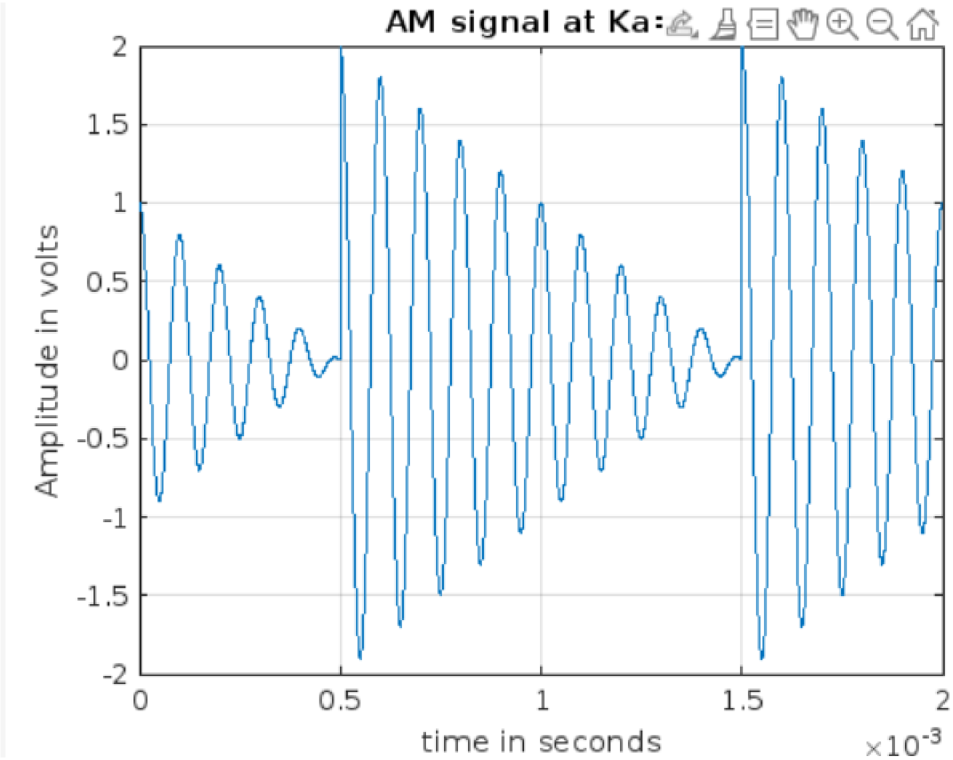


Ka = 0.5, Ac = 1 ➔ Am = ka x Ac = 0.5V

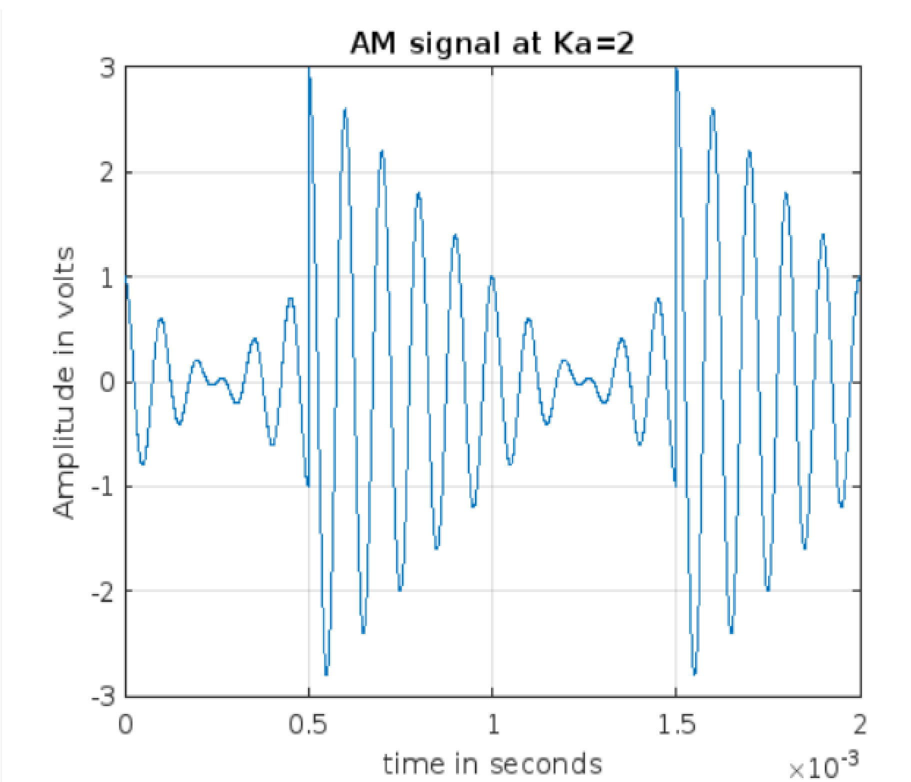
The modulated signal s(t) of a DSB-LC has an envelope that is proportional to the modulating signal. Since the modulation index is < 1, a non-coherent demodulator can be used for demodulation, i.e Envelope detector.

We can also see that the frequency of the signal is un-altered and the variation is present in the amplitude.

3. Repeat the previous steps for *K*a = 1 and *K*a = 2. Comment on the plots you obtain.



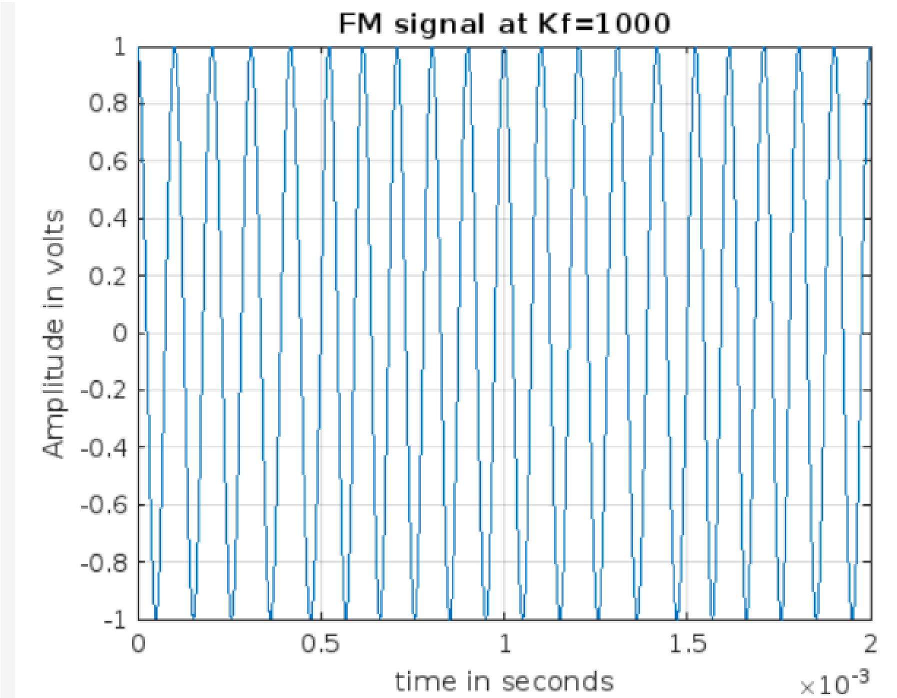
At Ka = 2



Comments:

- At Ka = 1, we are borderline able to use a non-coherent modulator.
- At Ka = 2, there is a phase inversion in the signal. We are not able to use a non-coherent modulator since the envelope is no longer proportional to the modulating signal.

4. Generate an FM signal for the same carrier then Plot the FM signal and comment on it.



Comment:

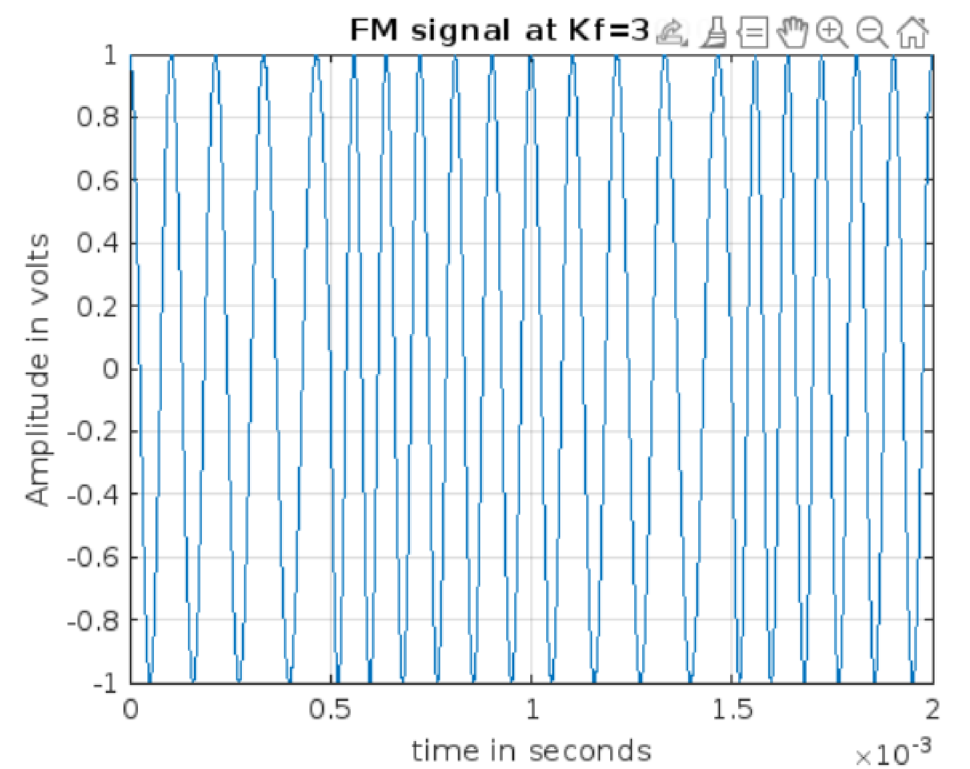
For Kf = 1000, we know that Beta = Am*Kf/fm

➔ Beta = 1

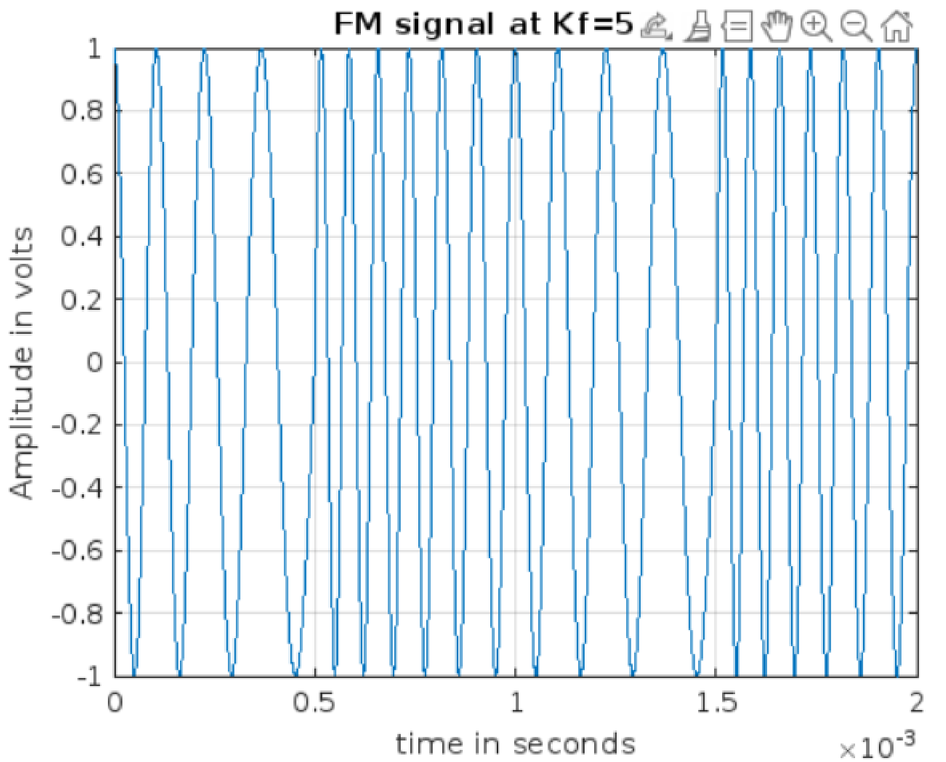
We have an FM signal and hence its instantaneous frequency is proportional to the information signal.

5. Repeat the previous steps for $Kf = 3000$ and $Kf = 5000$. Comment on the plots you obtain.

At Kf = 3000



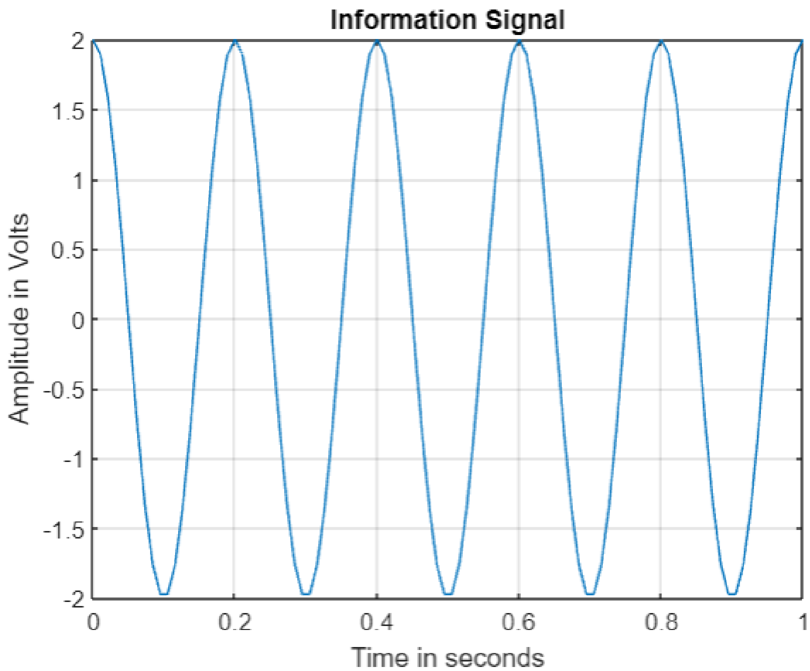
At Kf = 5000



As the value of Kf increases, the changes in the frequency of the modulated signal become more significant and observable; the maximum frequency deviation is larger.

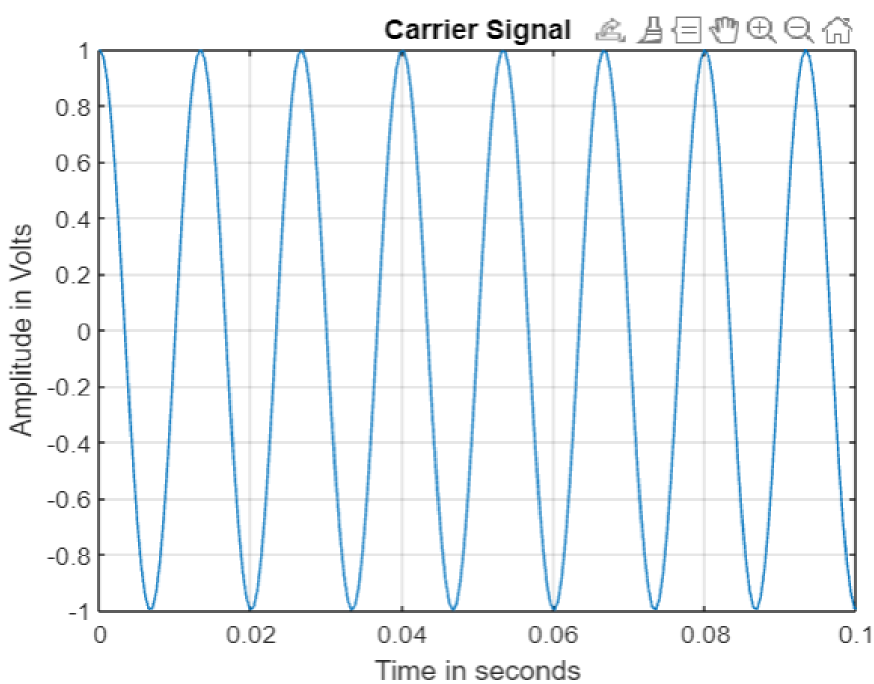
(Part II – SSB)

1. Generate the sinusoidal message signal $m(t)$, with an amplitude of 2 volts and a frequency of 2 KHz and plot it.

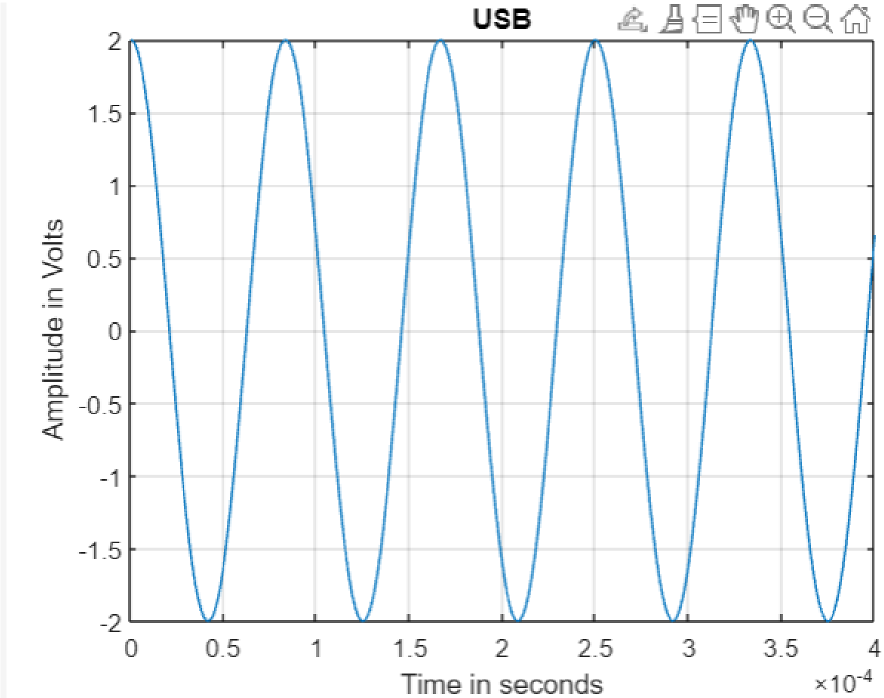


2. Generate the modulated signal, $s(t)$, output of the block shown in Fig. 2 using a carrier wave $c(t)$ of 1 Volt amplitude and 10 KHz frequency and plot USB and LSB.

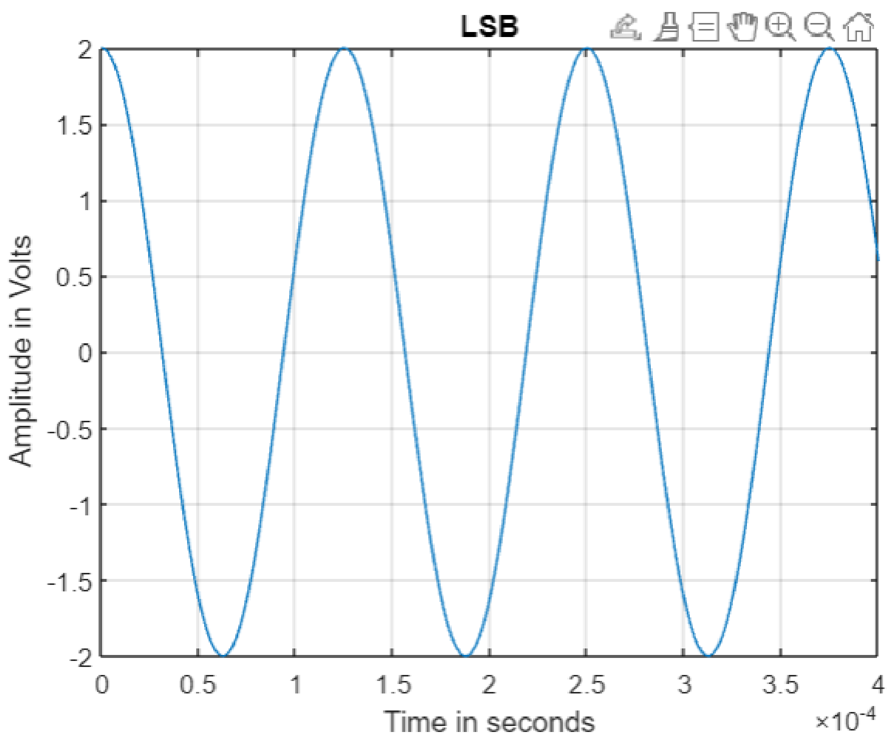
The Carrier signal is shown:



The USB is shown:



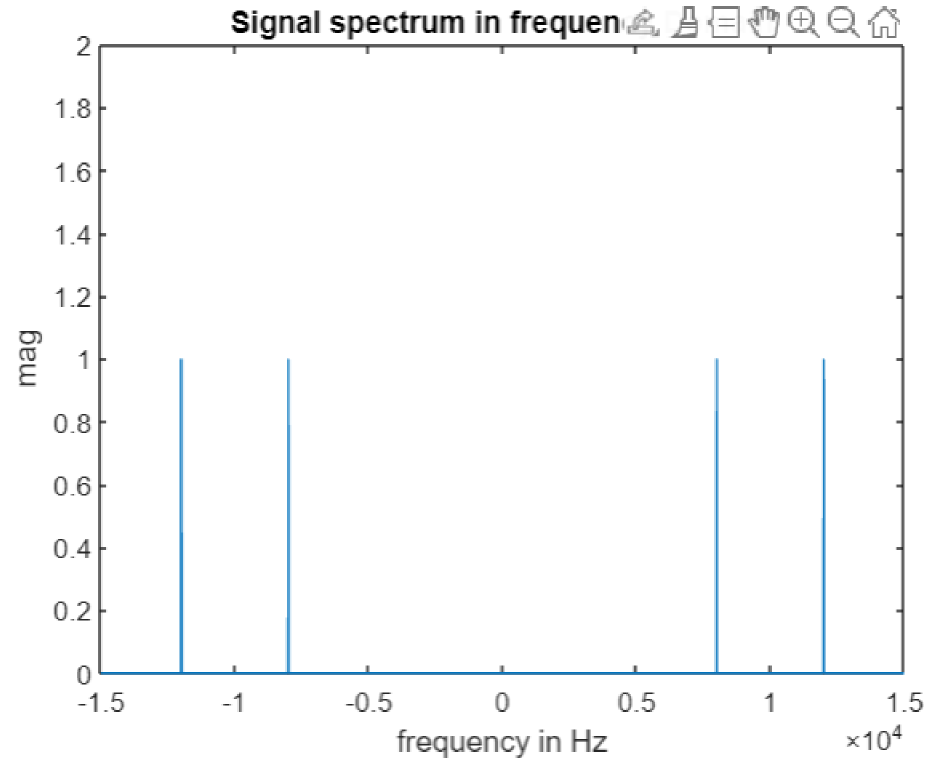
The LSB is shown:



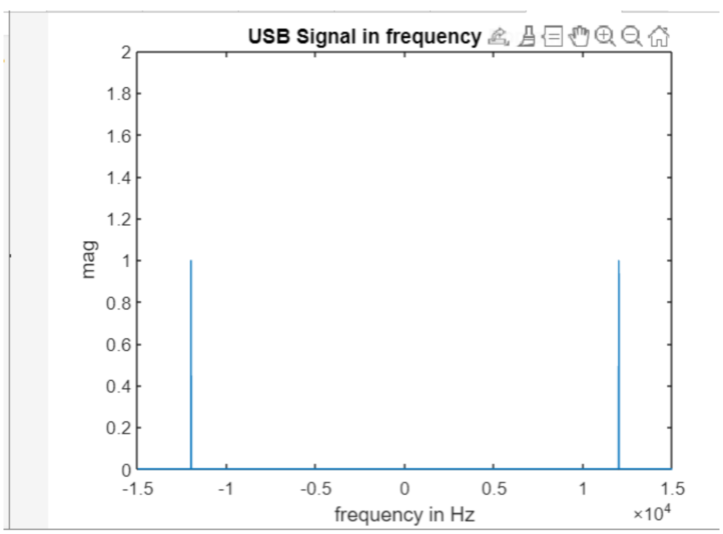
In the same time window, we see more cycles of the USB signal. This affirms our knowledge that it has a higher frequency.

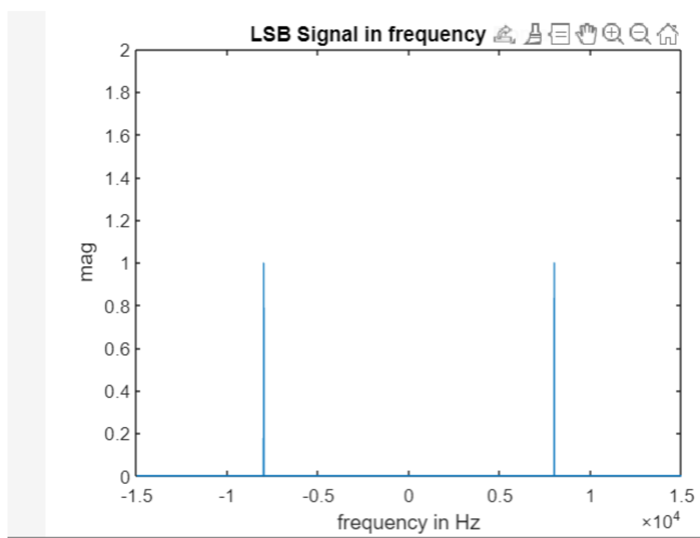
3. Obtain the frequency spectrum of the modulated signal.

The signal spectrum is shown:



USB at +- 12kHz **LSB** at +- 8kHz

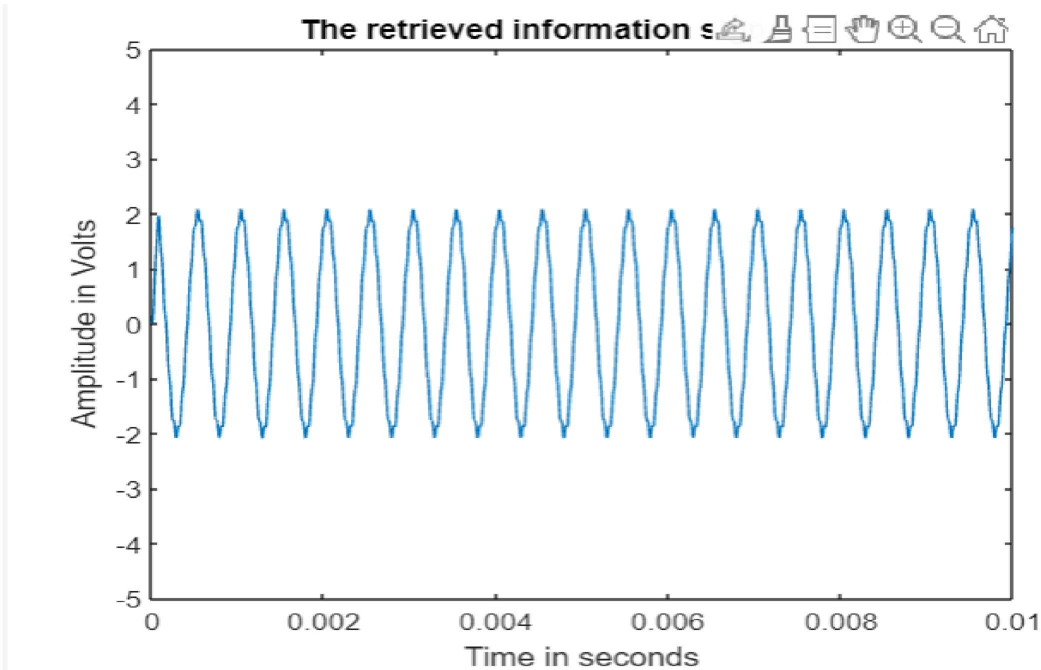




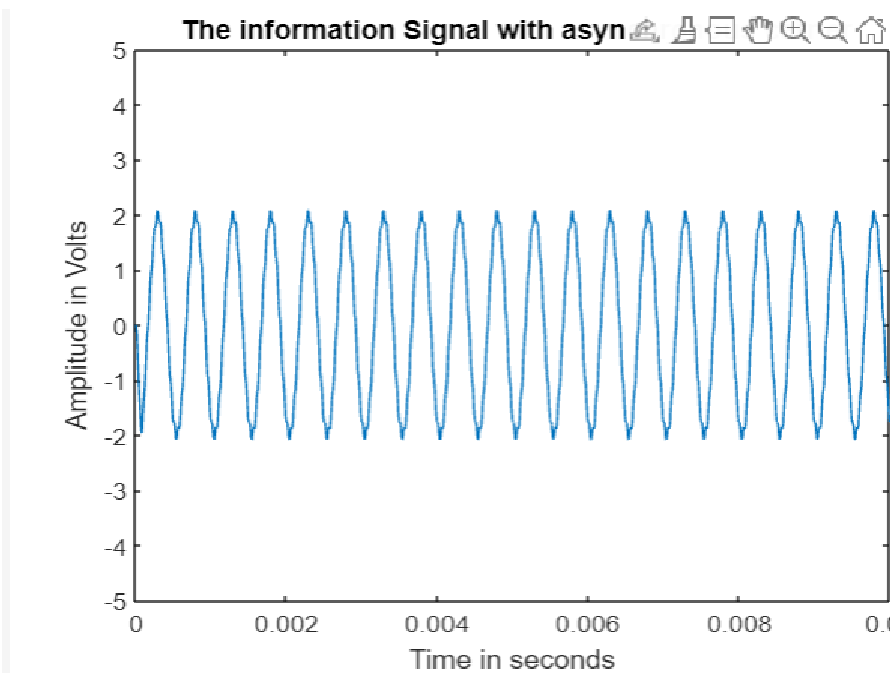
4. Implement a suitable demodulator to extract $m(t)$ from $s(t)$.

The demodulator function is implemented in code and does the function of the modulator in the document figure.

The retrieved information signal m(t) is shown



5. Investigate the output of the previous step if the generator carrier wasn't perfectly synchronized with the used one in modulator. Comment on the plots you obtain.



Comments:

Some attenuation and distortion could be observed in the amplitude due to the non-perfect carrier synchronization.

This problem can be solved by using a square law device (SLD) or a phase locked loop (PLL).