The British University In Egypt الـجامعة البريطانية في مصر	**Electrical & Communications Engineering Department** **Module Name: Analog Communication** **Module Code: 22ECE12I** **Semester: Two 23-24**
Matlab Laboratory	**Lab Title: Amplitude Modulation** **Lab No.: 2**

Theory:

Modulation is defined as the process by which some characteristics of a carrier signal is varied in accordance with a modulating signal. The base band signal is referred to as the modulating signal and the output of the modulation process is called as the modulated signal.

AMPLITUDE MODULATION

Amplitude modulation is defined as the process in which amplitude of the carrier wave is varied in accordance with the instantaneous values of the modulating signal. The envelope of the modulated wave has the same shape as the base band signal provided the following two requirements are satisfied:

1. The carrier frequency fc must be much greater than the highest frequency components f_m of the message signal $m(t)$ i.e.$f_c >> f_m$
2. The modulation index must be less than unity. If the modulation index is greater than unity, the carrier wave becomes over modulated.

AMPLITUDE DEMODULATION

The process of detection provides a means of recovering the modulating Signal from modulated signal. Demodulation is the reverse process of modulation. The envelope detector circuit is employed to separate the carrier wave and eliminate the side bands. Since the envelope of an AM wave has the same shape as the message, independent of the carrier frequency and phase, demodulation can be accomplished by extracting envelope.

An increased time constant RC results in a marginal output follows the modulation envelope. A further increase in time constant the discharge curve become horizontal if the rate of modulation envelope during negative half cycle of the modulation voltage is faster than the rate of voltage RC combination, the output fails to follow the modulation resulting distorted output is called as diagonal clipping: this will occur even high modulation index. The depth of modulation at the detector output greater than unity and circuit impedance is less than circuit load results in clipping of negative peaks of modulating signal. It is called “negative clipping”.

In AM, there is a carrier and two side bands. The carrier itself does not carry any information. If the carrier is 100 % modulated by a signal, each side band is one fourth of the carrier’s power. If receiver uses only one sideband, it is only one sixth of the total power radiated by the transmitter. One way to improve the AM transmitter's efficiency is to use a technique called as suppressed carrier modulation. Balance modulator is an AM modulator in which carrier and modulating signal are introduced in such a way that the output contains the two sidebands without the carrier, that is double side band suppressed carrier (DSB-SC).

Objectives:

1) To understand the modulation process and utilize AM to modulate the amplitude of a carrier signal.
2) To investigate the effect of multiplying the carrier by the modulating signal, and observe the resulting sidebands.

Prerequisites:

1) Basic familiarity with Simulink and Matlab environment.

Procedures:

Task 1: (AM Modulation)

Section 1:

1) Use Matlab's simulink to generate a carrier sine wave signal with frequency of 20 kHz, sample time of 0.02 sec, and 1V peak.
2) Generate a baseband sine wave signal of frequency 1 kHz, sample time of 0.02 sec, and amplitude of 1V peak.
3) Use a simple multiplier to obtain the amplitude modulated signal.
4) Display both inputs and the resulting amplitude modulated signal simultaneously on oscilloscopes.
5) Draw the three signals showing axes values and amplitudes.
6) Change the amplitude of the modulating signal upwards and downwards while fixing the amplitude of the carrier and draw the three signals in each case (Use four different frequencies).
7) Repeat the above step but this time changes the amplitude of the carrier and fix the amplitude of the signal.
8) Displayed the spectrum of the DSB-SC signal.
9) Comment on the effect of changing the modulation index on the resulting modulated signal.

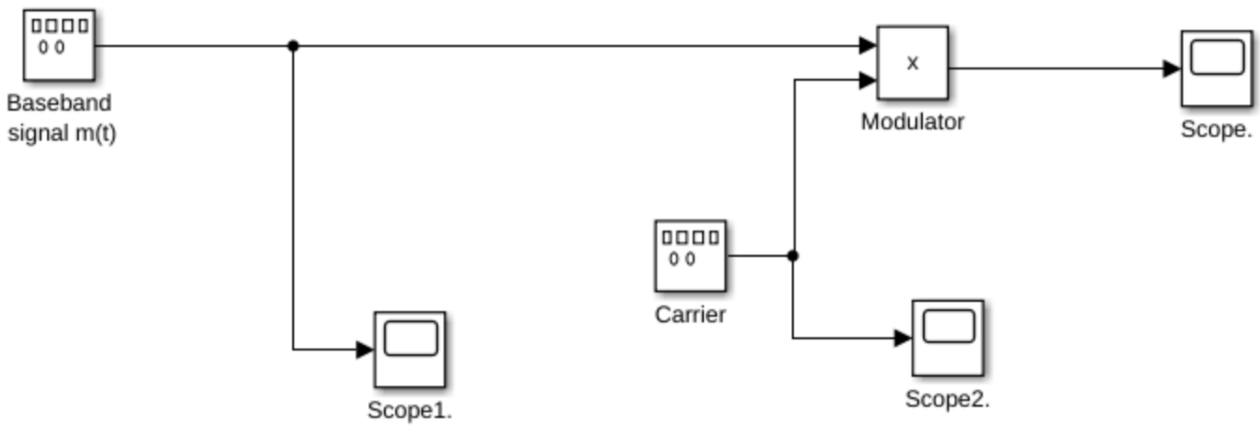

Figure1 Task 1.1 DSB-SC Modulator Connection Diagram

Section 2:

1) Use Matlab's simulink to implement the AM (DSB-WC) Modulation technique.
2) Change the modulation index from 0.2 to 1 in steps of 0.2, and draw the three signals in each case (Use four different frequencies).
3) Displayed the spectrum of the AM signal.
4) Compare the Results from Section 1 and Section 2 between the two modulation techniques (DSB-SC and DSB-WC).

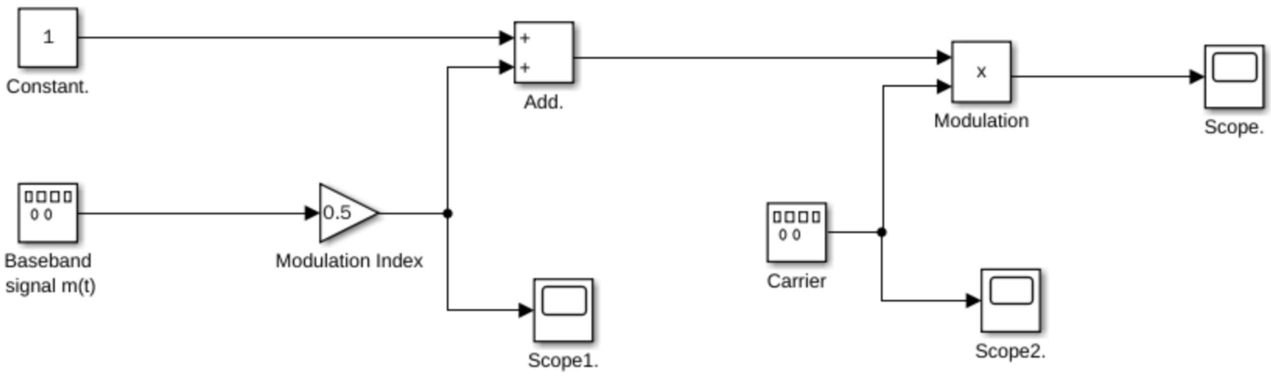

Figure2 Task 1.2 AM Modulator Connection Diagram

Hint:

Use the same parameters as section one for the modulating signal and the carrier signal at step (1).

Individual task:

Task 2: (DSB-SC Demodulation)

1) Verify that demodulation can be accomplished by a further modulation process.

2) For each frequency value in Task 1, display the demodulated signal on an oscilloscope and draw it on an appropriate scale.

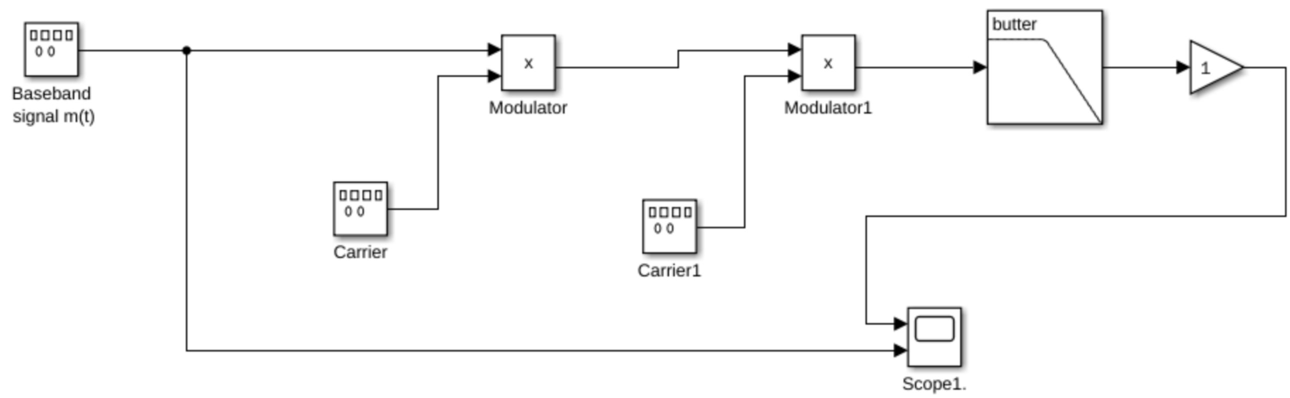

Figure3 Task 2 DSB-SC Demodulator Connection Diagram

Hint:

You will use a LPF in the demodulation process; it can be found in the "Signal Processing Blockset" under the category of "Filtering -> Filter Design".

Report:

Attach a report listing all your answers, drawings, and comments indicating question numbers.

Performance Measure:

Participation	Quality of Answers
15	15