AMERICAN INTERNATIONAL UNIVERSITY–BANGLADESH (AIUB)

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING

DATA COMMUNICATION LABORATORY

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Section: I

Group: 4

EXPERIMENT NO: 7 (Part 1)

Study of Amplitude Modulator and Demodulator using Simulink

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Abstract:

This experiment is designed to enhance understanding and practical application of Amplitude Modulation (AM) and demodulation using Simulink. Participants will utilize Simulink to implement AM modulation, gaining hands-on experience in signal generation. The focus then shifts to understanding AM demodulation techniques, potentially involving the use of filters. Overall, the experiment provides a comprehensive learning opportunity for participants to explore and apply AM modulation and demodulation concepts in a Simulink environment.

Introduction:

Amplitude modulation (AM) is a one of the conventional technique used to transmit message signals using a carrier wave. The amplitude or strength of the high frequency carrier wave is modified in accordance with amplitude of the message signal. [1] [2]

- Carrier signal (S_c) = $A_c\sin(2\pi f_c t)$
- Message signal (S_m) = $A_m\sin(2\pi f_m t)$ # fm must be smaller than fc

When carrier amplitude is altered with respect to message signal,

- Modulated Signal = $(A_c + A_m\sin(2\pi f_m t))*\sin(2\pi f_c t)$

In terms of modulation index (m=Am/Ac) the equation becomes

- **Modulated signal= $(1+ m\sin(2\pi f_m t))*A_c\sin(2\pi fct)$**

Where,

- A_c = Carrier signal amplitude
- A_m = Message signal amplitude
- f_c= Carrier frequency
- fm =Message frequency

Generating AM in Simulink

For generating AM we just have to implement the equation of AM in block level.

Blocks Required

Analyzing the equation we need,

1. Carrier Signal Source
2. Message Signal Source

3. Blocks for viewing the signals – Scope
4. Product Block
5. Summer Block
6. Constant Block

We can find these blocks in the following locations of Simulink Library…

Carrier, Message, Constant blocks

- Simulink –> Sources –> Sine wave
- Simulink –> Sources –> Constant

View Block

- Simulink –> Sink –> Scope

Product and Summer Block

- Simulink –> Math Operations–> Product
- Simulink –> Math Operations–> Summer

Block Diagram

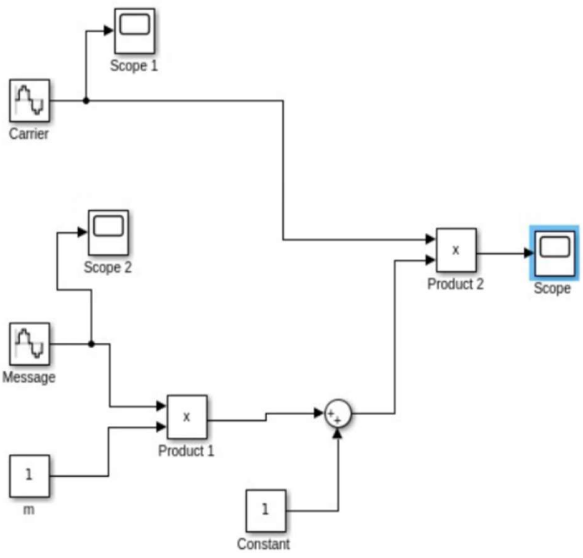

Figure 1: AM Modulation

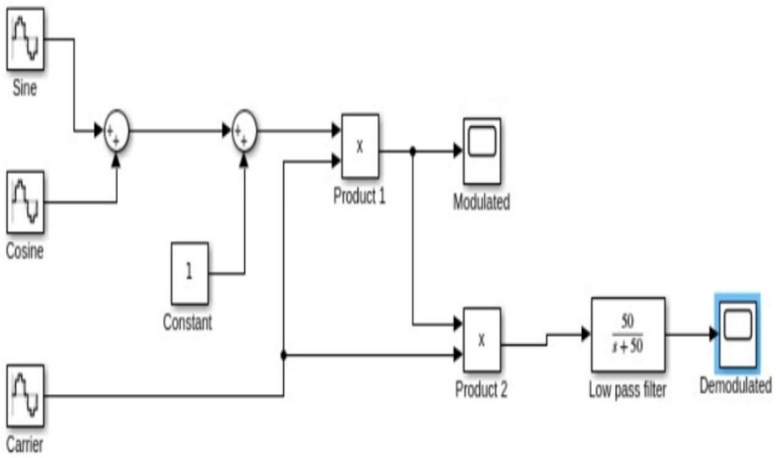

Figure 2: AM Modulation & Demodulation

Block parameters can be changed by selecting the block and parameter:

- Carrier Signal frequency = 2*pi*3 and sampling time=1/5000
- Message Signal frequency = 2*pi and sampling time=1/5000
- Amplitudes of both signals are 1

Results:

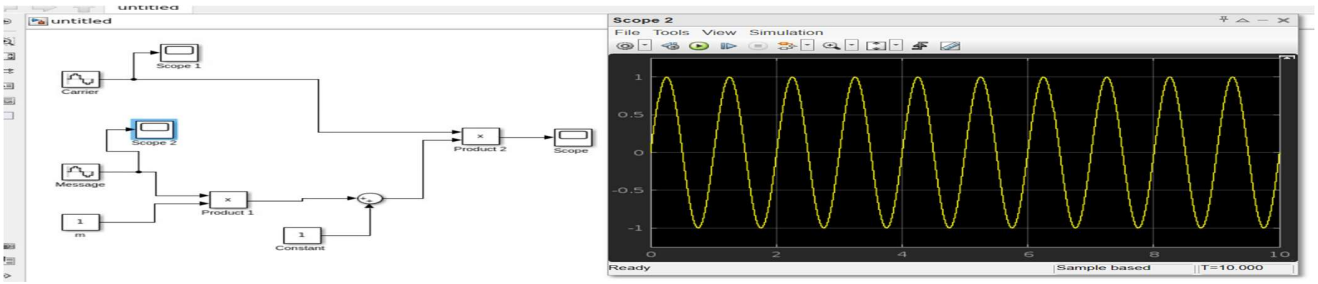

Figure 3: *AM Generation using Simulink – Message Signal*

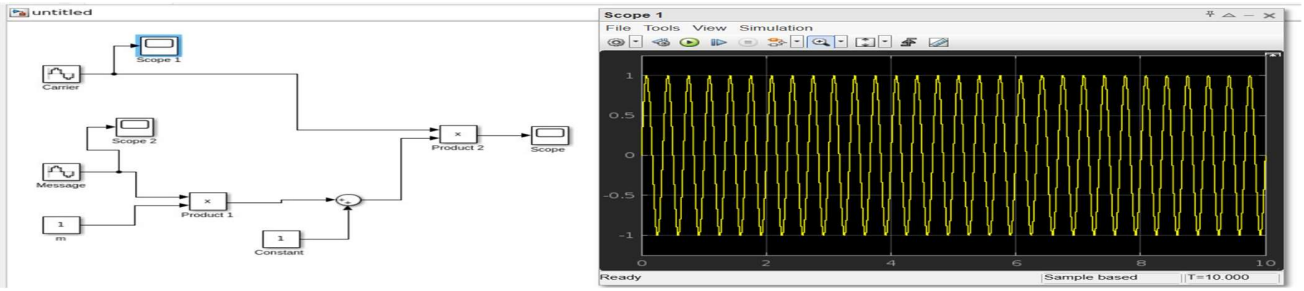

Figure 4: *AM Generation using Simulink – Carrier*

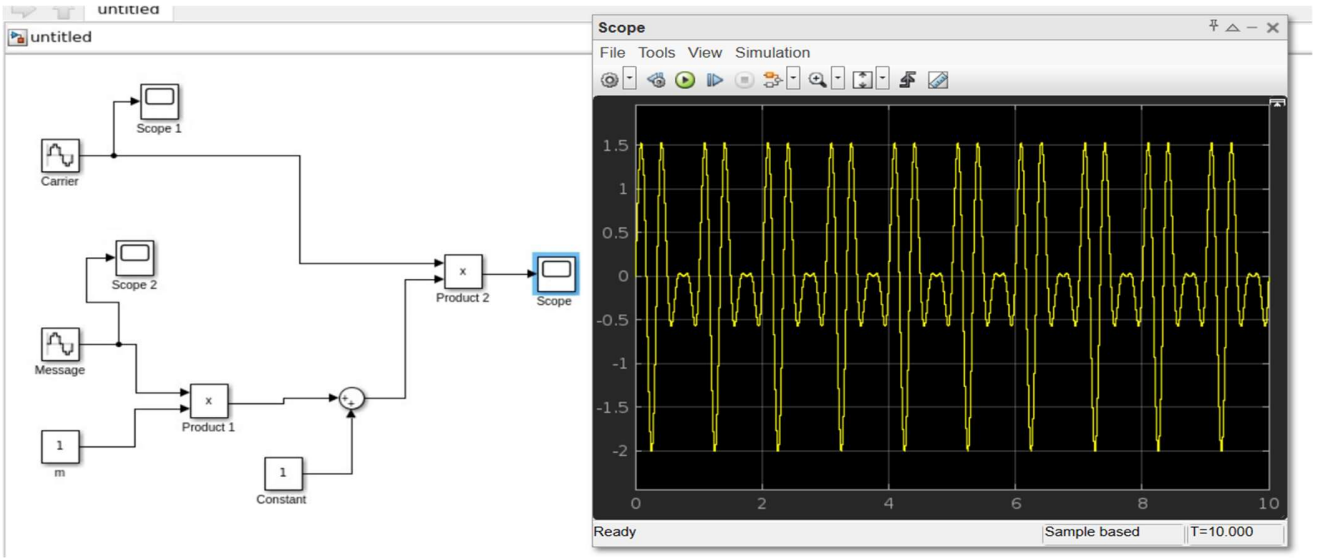

Figure 5: *AM Generation using Simulink – Modulated Signal*

Performance Task:

Question:

Implement the following demodulation in Simulink to retrieve the original signal:

You have a signal 'm(t) = (2*sin(2*pi*4*t)+3*cos(2*pi*6*t))'. Apply amplitude modulation (AM) on the given signal with carrier signal 'c(t) = cos(2*pi*50*t)', and then do demodulation to recover the original message signal m(t).

Answer:

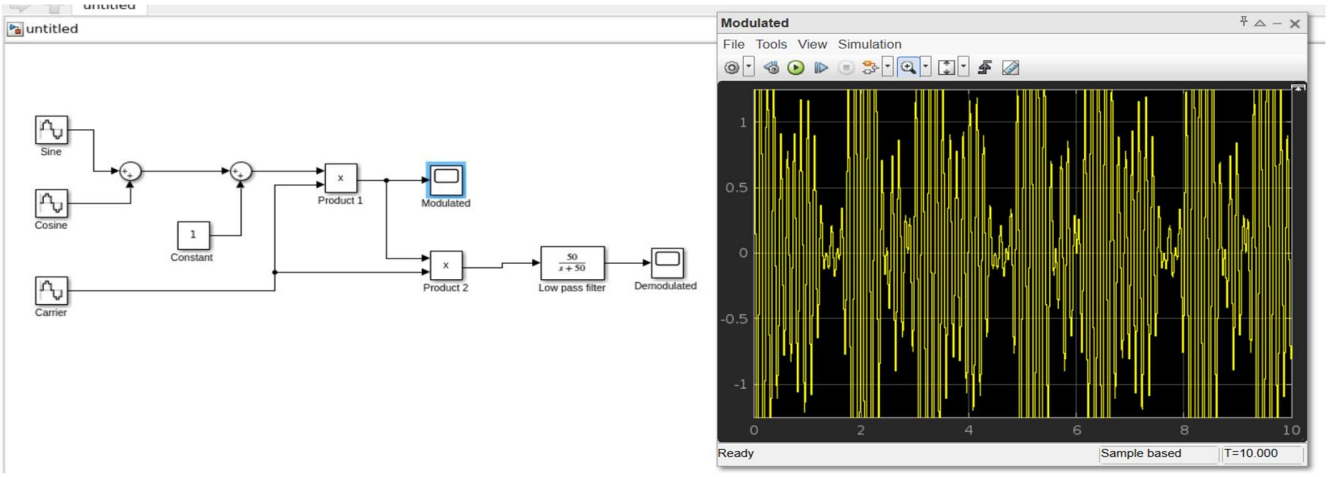

Figure 6: *AM Generation*

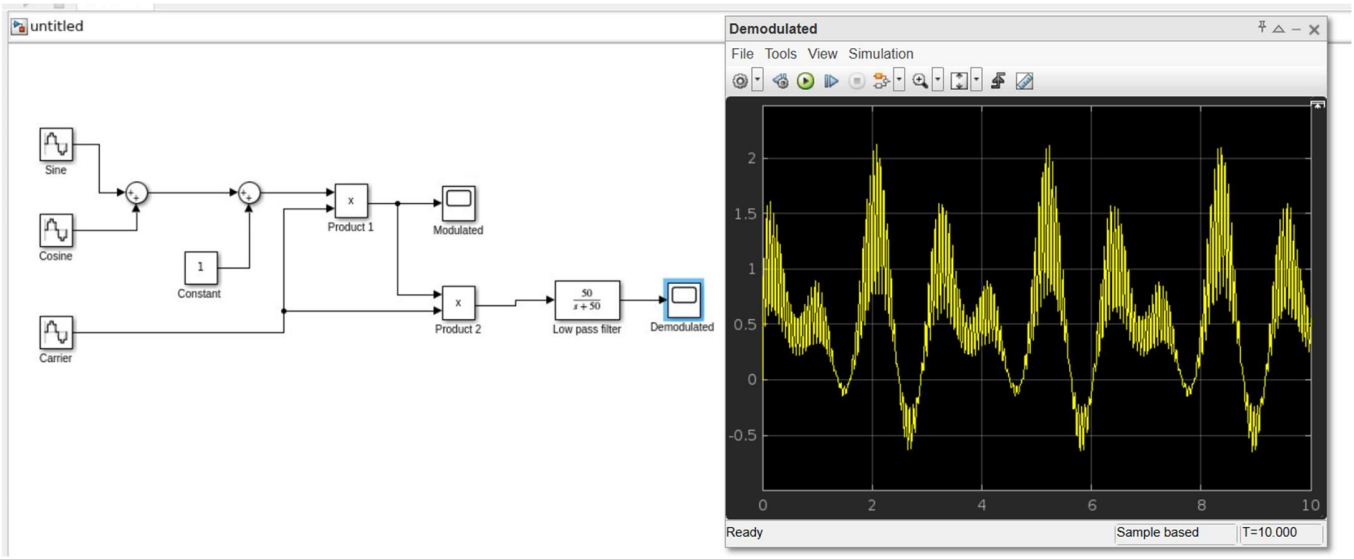

Figure 7: *AM Demodulation*

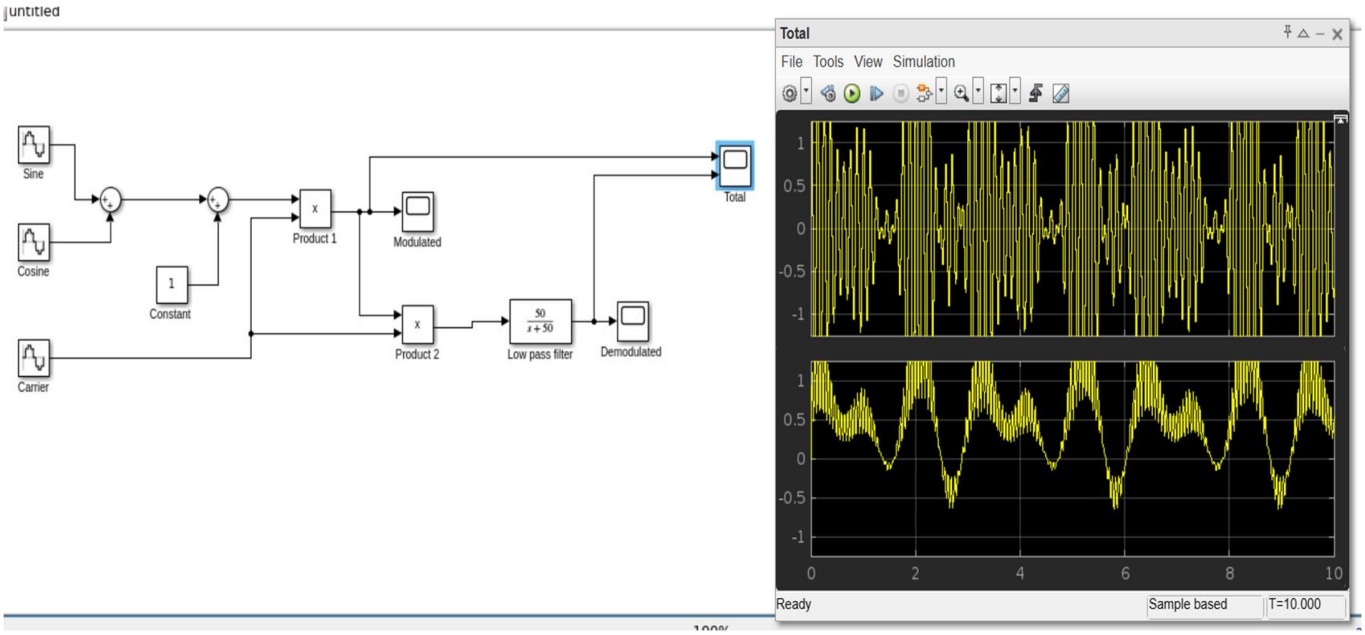

Figure 8: *Modulation and Demodulation in single Scope*

Discussion & Conclusion:

The experiment involved implementing an amplitude modulator and demodulator in Simulink using MATLAB. Sine and cosine values were chosen as per the task requirements, and necessary components like scopes and math functions were included for the desired output. This hands-on application within the Simulink environment provided practical insights into amplitude modulation techniques. The successful execution of modulation and demodulation tasks demonstrated the effective application of theoretical concepts in a MATLAB context.

References:

[1] W. Stallings, Data and computer communications. 2000., Accessed: Nov.24, 2023. [Online]. Available:https://www.portcity.edu.bd/files/636444710465881602_Dataandcomputercommunications.pdf [Online Copy]

[2] B. A. Forouzan, C. A. Coombs, and S. C. Fegan, Introduction to data communications and networking. McGraw-Hill Science, Engineering & Mathematics, 1998., Accessed: Nov.24, 2023. [Online]. Available: https://archive.mu.ac.in/myweb_test/syllFybscit/dcn.pdf [Online Copy]