AMERICAN INTERNATIONAL UNIVERSITY BANGLADESH

Faculty of Engineering

Laboratory Report Cover Sheet

Students must complete all details except the faculty use part.

Please submit all reports to your subject supervisor or the office of the concerned faculty.

Lab Title: Study of Amplitude and Frequency Modulator and Demodulator using Simulink

Experiment Number: **07** Due Date: **22 /04/2024** Semester: **Spring 2023-2024**

Subject Code: **COE3103** Subject Name: **DATA COMMUNICATION** Section: **E**

Course Instructor: **NOWSHIN ALAM** Degree Program: **B.Sc. CSE**

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Faculty comments_____

PART-1

Introduction:- Amplitude modulation (AM) stands as a fundamental method in the realm of signal transmission, where information is conveyed through the manipulation of a carrier wave's Amplitude. In this conventional technique, the strength of a high-frequency carrier wave is adjusted in accordance with the amplitude variations of the message signal.

Basically, In AM transmission, the carrier is modulated so its amplitude varies with the changing amplitude changes to follow variations in the information. AM is normally implemented by using a simple multiplier because the amplitude of the carrier signal needs to be changed according to the amplitude of the modulating signal.

Theory:-

Mathematically,

the carrier signal (S_c) represents $A_c \sin(2\pi f_c t)$

the message (S_m) = $A_m \sin(2\pi f_m t)$

the modulated = $(A_c + A_m \sin(2\pi f_m t)) \times \sin(2\pi f_c t)$

the modulation Index, $m = \frac{A_m}{A_c}$

where the equation simplifies to $(1 + m \sin(2\pi f_m t)) \times A_c \sin(2\pi f_c t)$

Block Diagram:

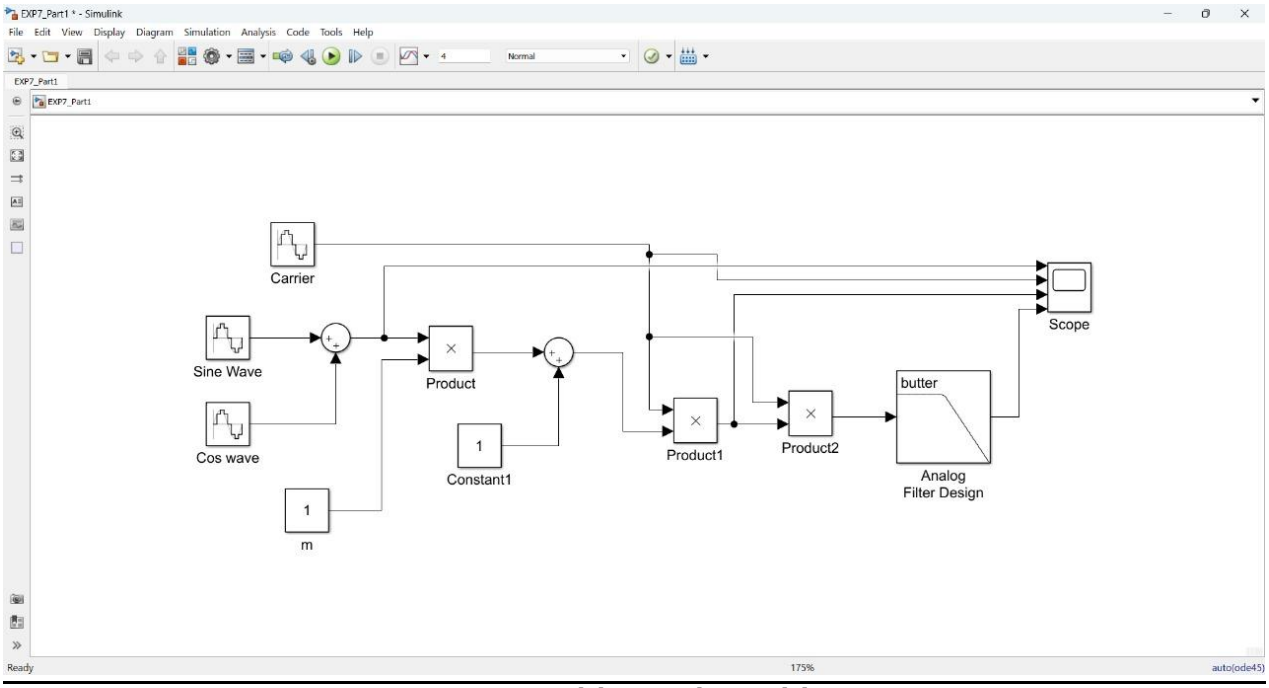
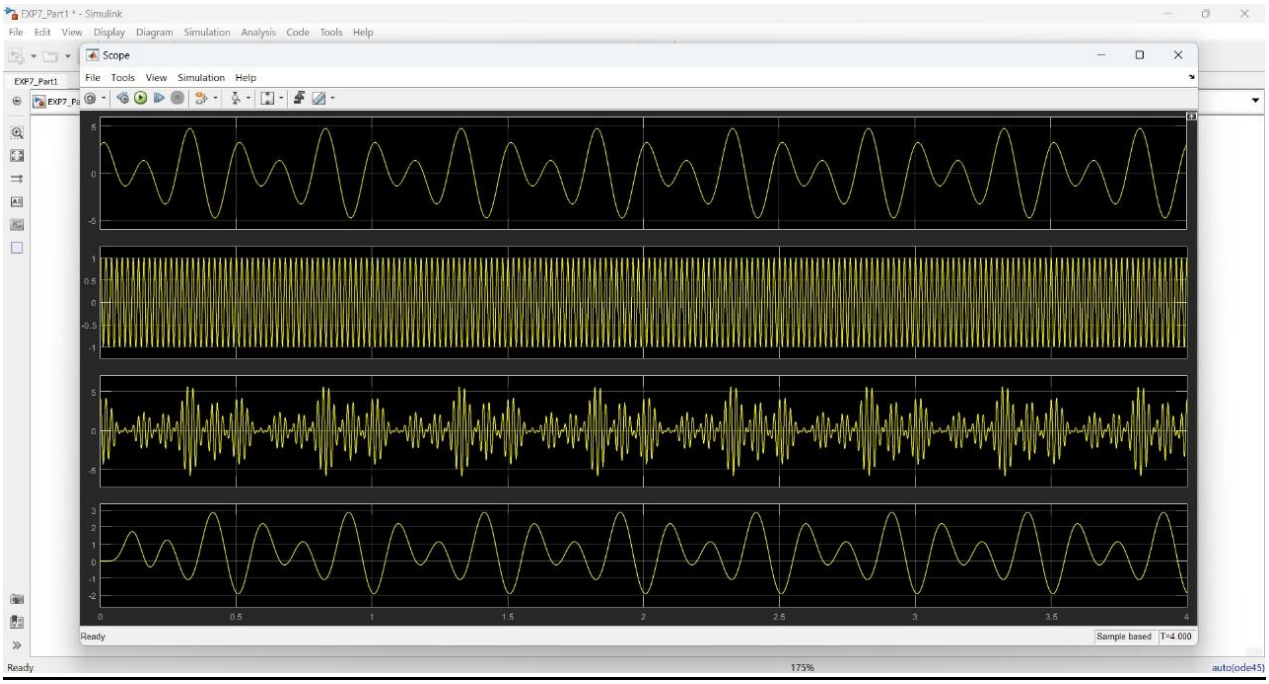


Figure: AM Modulation and Demodulation

Simulated Results:



PART-2

Introduction:-

In frequency modulated transmission, the frequency of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal. The peak amplitude and phase of the modulating signal and carrier signal remains constant, but as the amplitude of the information on the message signal changes, the frequency of the carrier changes correspondingly.

Theory:-

If the message signal is m(t), the frequency modulated signal is expressed as in the time Domain,

$$s(t) = A_c \cos\left[2\pi f_c t + k_f \int_{-\infty}^{t} m(\lambda)\, d\lambda\right]$$

For frequency demodulation, one widely employed technique is Phase Locked Loop (PLL). In this method, the PLL operates by using feedback to ensure a voltage controlled Oscillator (VCO) remains synchronised with the carrier wave of the incoming signal. Consequently, the message signal is retrieved as the control input of the VCO.

Block Diagram:

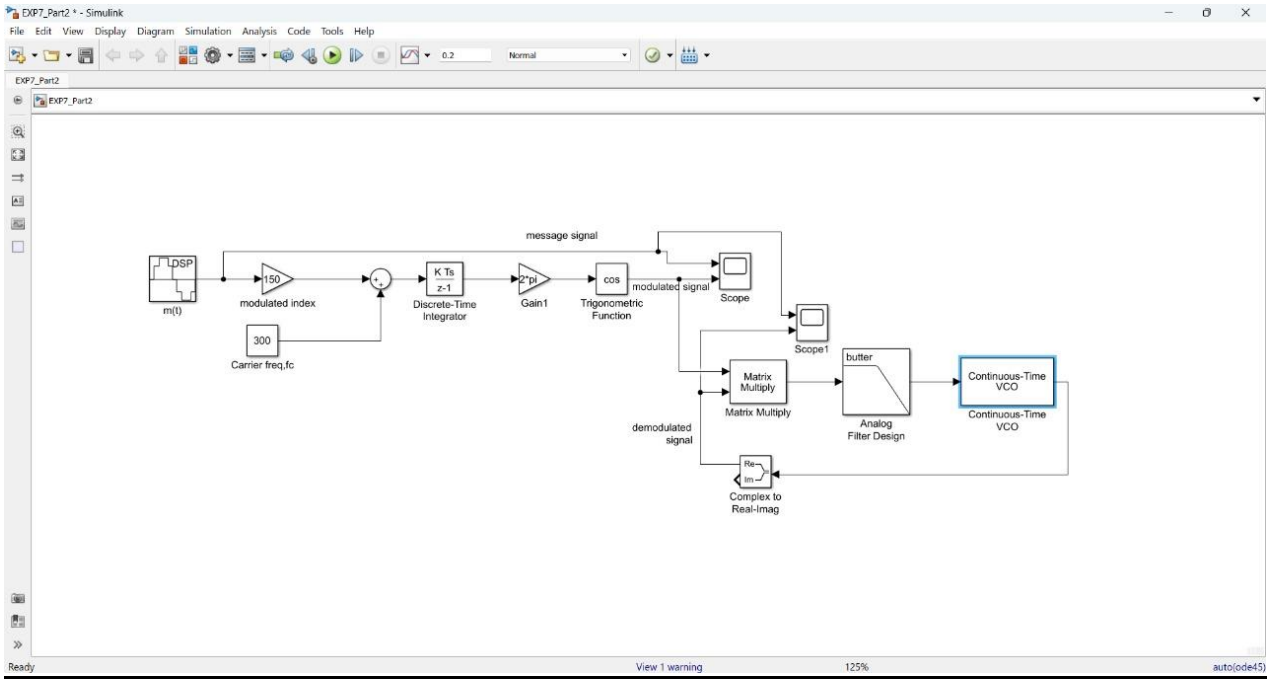
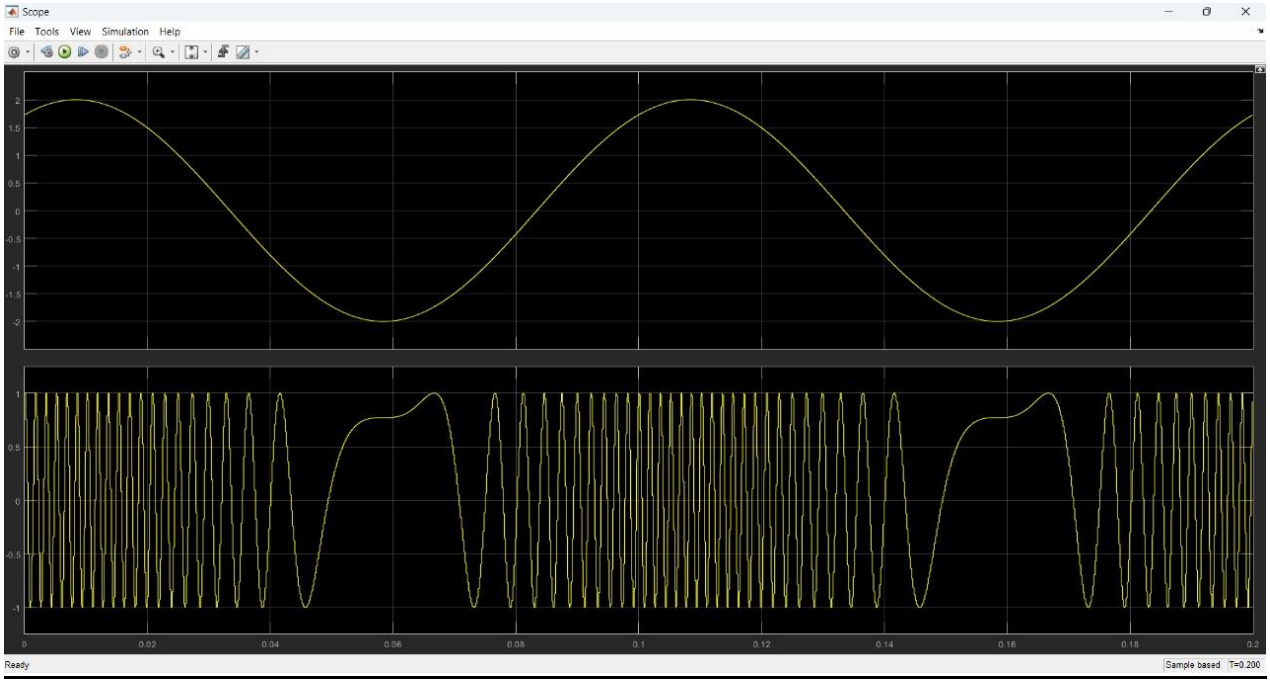
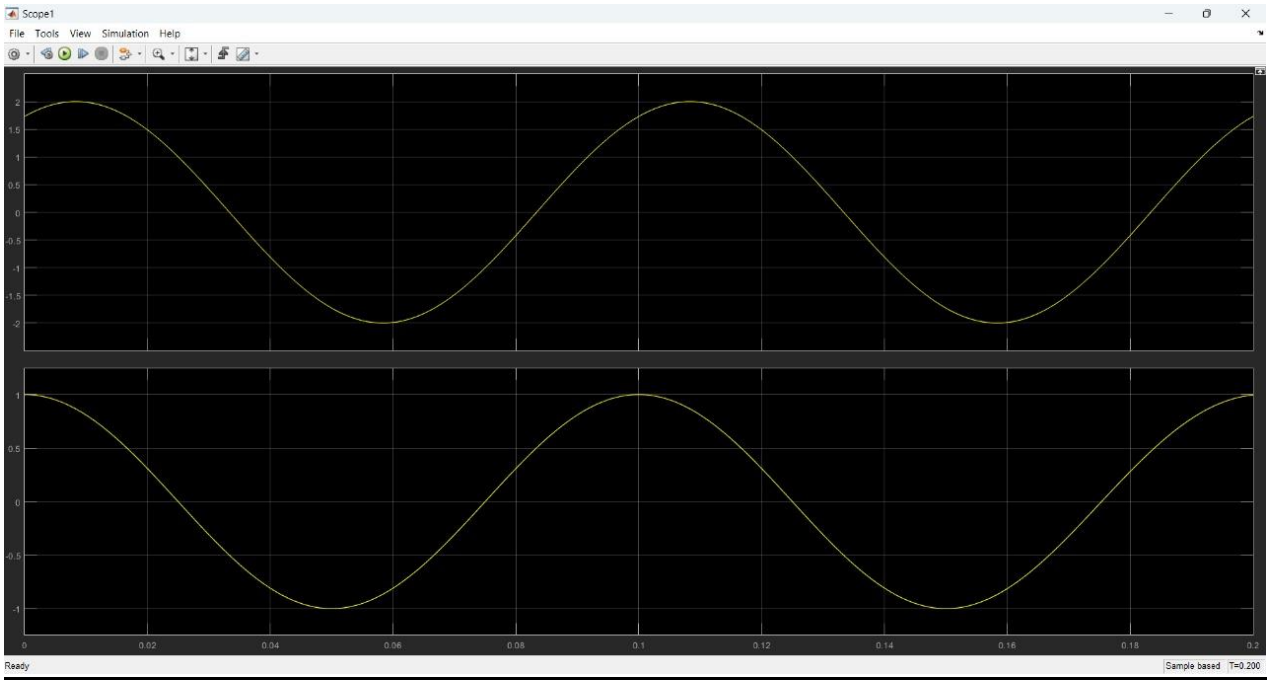
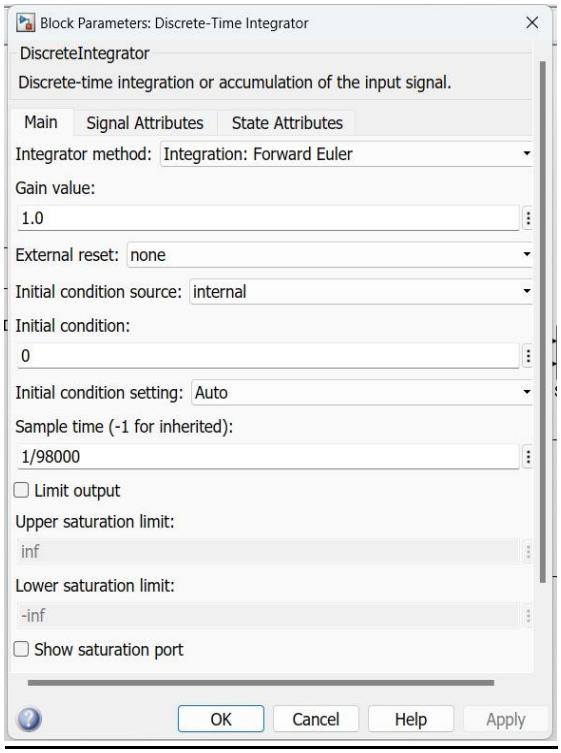


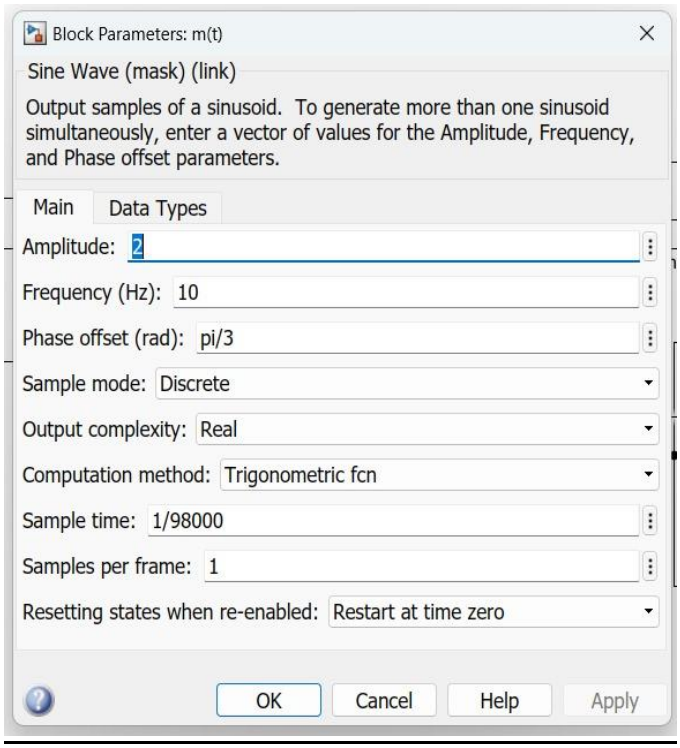
Figure: FM Modulation and Demodulation

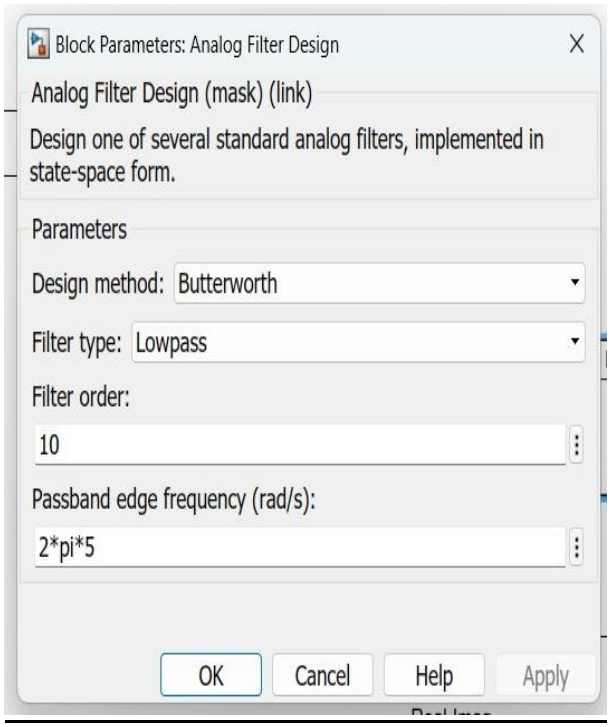
Simulated Results:

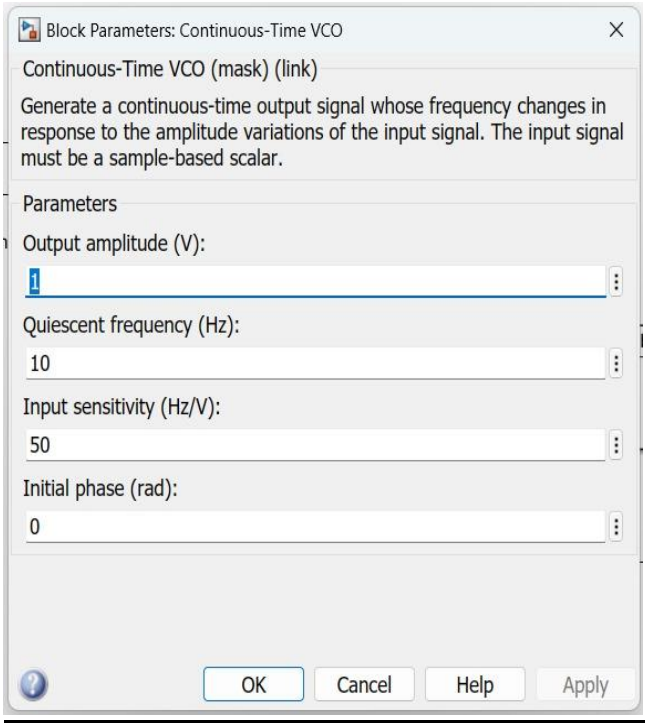



Scope1
File Tools View Simulation Help
Ready
Sample based T=0.200


Block Parameters: Discrete-Time Integrator
DiscreteIntegrator
Discrete-time integration or accumulation of the input signal.
Main
Signal Attributes
State Attributes
Integrator method: Integration: Forward Euler
Gain value:
1.0
External reset: none
Initial condition source: internal
Initial condition:
0
Initial condition setting: Auto
Sample time (-1 for inherited):
1/98000
Limit output
Upper saturation limit:
inf
Lower saturation limit:
-inf
Show saturation port
OK
Cancel
Help
Apply


Block Parameters: m(t)
Sine Wave (mask) (link)
Output samples of a sinusoid. To generate more than one sinusoid simultaneously, enter a vector of values for the Amplitude, Frequency, and Phase offset parameters.
Main
Data Types
Amplitude: 2
Frequency (Hz): 10
Phase offset (rad): pi/3
Sample mode: Discrete
Output complexity: Real
Computation method: Trigonometric fcn
Sample time: 1/98000
Samples per frame: 1
Resetting states when re-enabled: Restart at time zero
OK
Cancel
Help
Apply


Block Parameters: Analog Filter Design
Analog Filter Design (mask) (link)
Design one of several standard analog filters, implemented in state-space form.
Parameters
Design method: Butterworth
Filter type: Lowpass
Filter order:
10
Passband edge frequency (rad/s):
2*pi*5
OK
Cancel
Help
Apply


Block Parameters: Continuous-Time VCO
Continuous-Time VCO (mask) (link)
Generate a continuous-time output signal whose frequency changes in response to the amplitude variations of the input signal. The input signal must be a sample-based scalar.
Parameters
Output amplitude (V):
1
Quiescent frequency (Hz):
10
Input sensitivity (Hz/V):
50
Initial phase (rad):
0
OK
Cancel
Help
Apply

Conclusion:-

In conclusion, the experiement was successfully achieved - and understanding the Principle of AM modulation - and demodulation using Simulink. we've gained Practical - experience in implementing modulation techniques and observed how changes in signal Parameter impact the modulated - output. Also, the demodulation techniques and understanding of signal Processing and communication system.

The knowledge and skills acquired from the experiement - can be applied to various communication systems. Like - telecommunication, broadcasting and wireless communication.

By mastering the concept of the AM and FM modulation and Demodulation techniques will help us to address challenges in signal Processing and communication system design, contributing to advancement in tele communication and various fields.