

EXPERIMENT NUMBER: 3

EXPERIMENT NAME: AMPLITUDE MODULATION AND DEMODULATION
USING GNU RADIO COMPANION

DATE: 31/10/2022, MONDAY

* AIM:

To perform amplitude modulation and demodulation for the given message and carrier signals.

* SOFTWARE REQUIRED:

- ① Oracle VM VirtualBox 6.1.38, Oracle Corporation
- ② Ubuntu 22.04 (64-bit) operating system
- ③ GNU Radio Companion Application, v3.10.1
(`sudo apt-get install gnuradio`)

* THEORY:

- A. Amplitude Modulation - Double-Sideband Suppressed carrier
DSB-SC in amplitude modulation is the process by which the message signal can be multiplied to a carrier signal which has a higher frequency which is done in modulation.

During modulation, the modulated signal is multiplied by carrier signal so that images could be demodulated by a low pass filter.

$$u(t) = m(t) * c(t), \text{ where -}$$

$u(t)$ is the modulated signal
 $m(t)$ is the message signal
 $c(t)$ is the carrier signal.

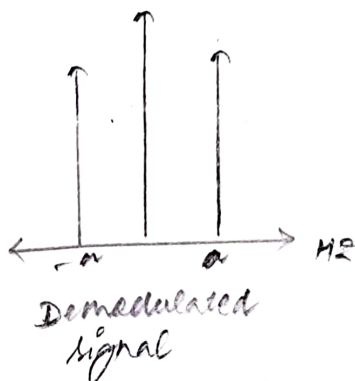
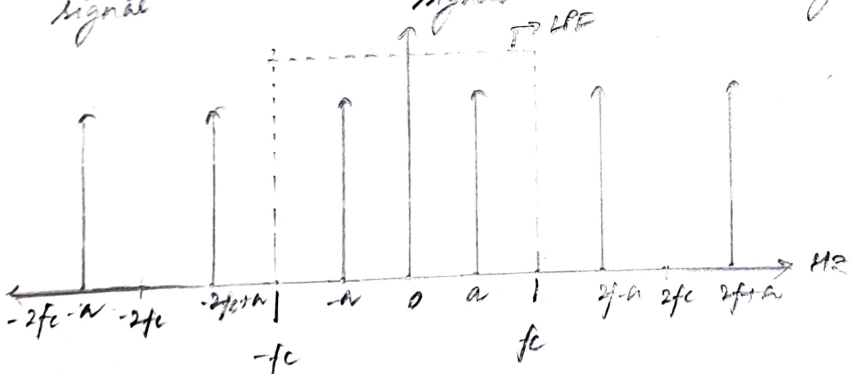
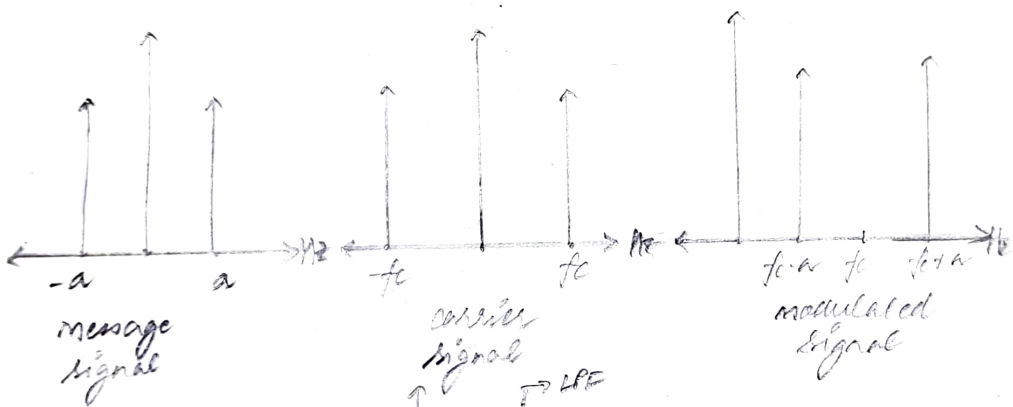
During modulation,

$$d_m(t) = u(t) * c(t)$$

Passing this through a low pass filter, we get $m(t)$.

MODULATION AND DEMODULATION OF SINGLE TONE SIGNAL :

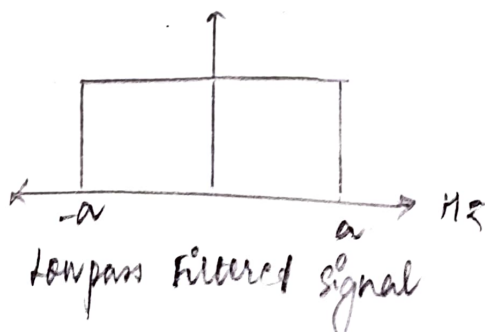
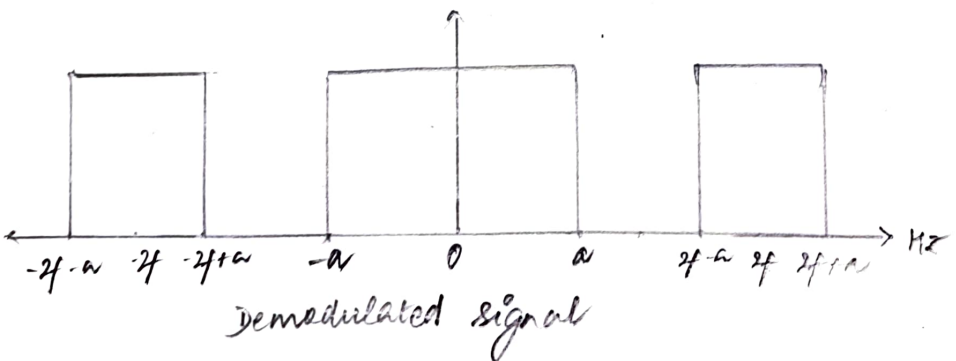
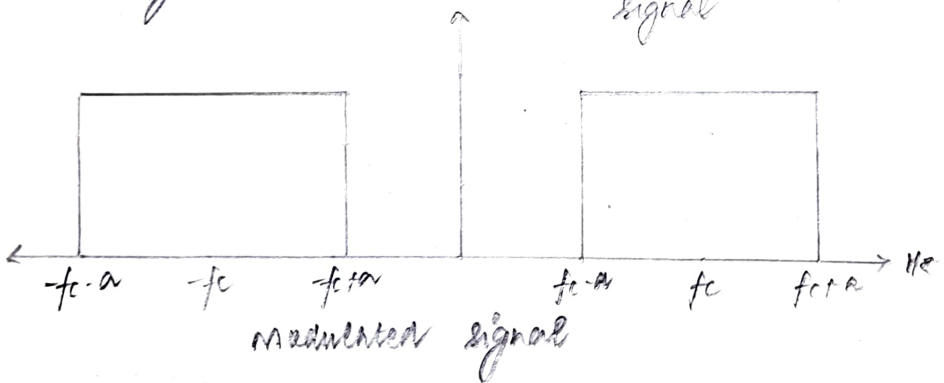
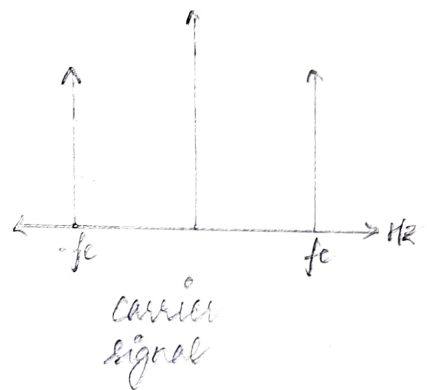
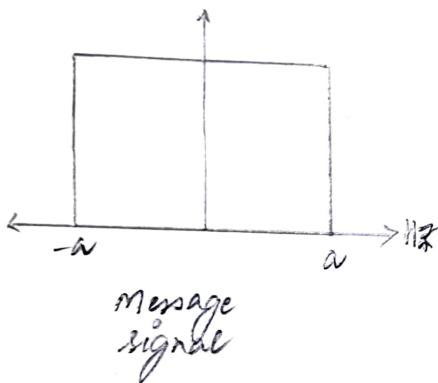
- ① A single tone can be represented in frequency domain as a single spike and the carrier signal can be expressed as a single spike at high frequency.
- ② During modulation, message signal is multiplied with carrier which is a frequency shift of message which is contained at zero frequency is shifted to f_c .
- ③ During demodulation, modulated signal is again multiplied to carrier signal so modulated will be centered at $2f_c$ because of which images will start to appear at original centered message signal, which can be obtained by passing through low pass filter.



Page - 11

C. MULTITONE AMPLITUDE MODULATION AND DEMODULATION -

- ① In a multitone frequency signal the frequency component will be a band of signal or multiple frequencies component centered at zero when multiplied with carrier for modulation it shifts its center to be during modulation.
- ② Similarly during demodulation it shifts its center to $2f_c$ and its images can be formed at original band which can be reconstructed by passing it through low pass filter.



→ Conventional AM is similar to DSB-SC with a DC shift with modulation and demodulation.

* GNU BLOCKS:

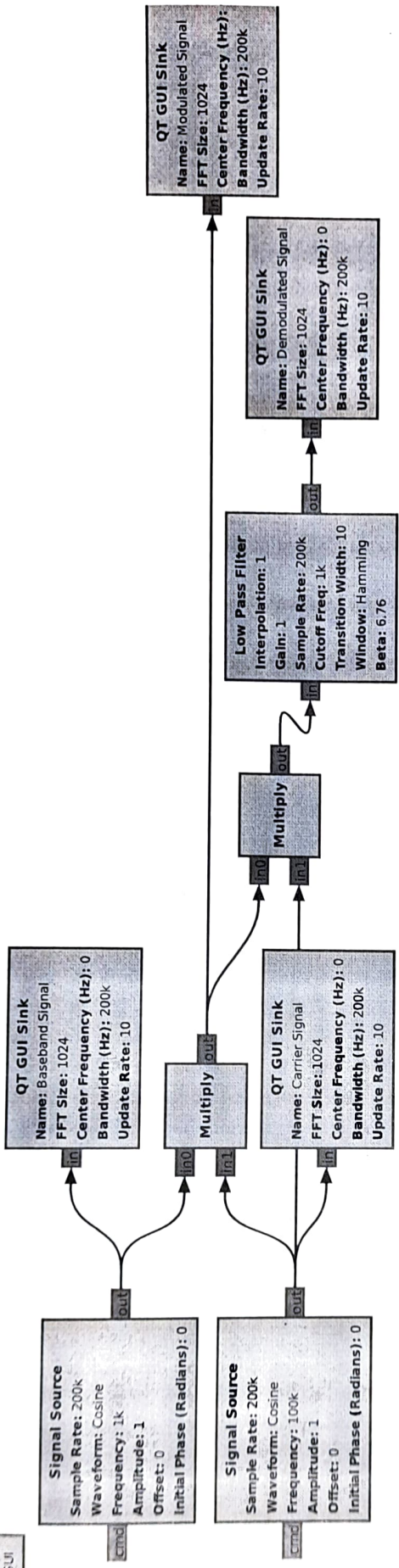
- A. MODULATION AND DEMODULATION OF SINGLE TONE SIGNAL -
- B. MULTITONE AMPLITUDE MODULATION AND DEMODULATION -
- C. AMPLITUDE MODULATION USING AUDIO FILE -

* RESULT:

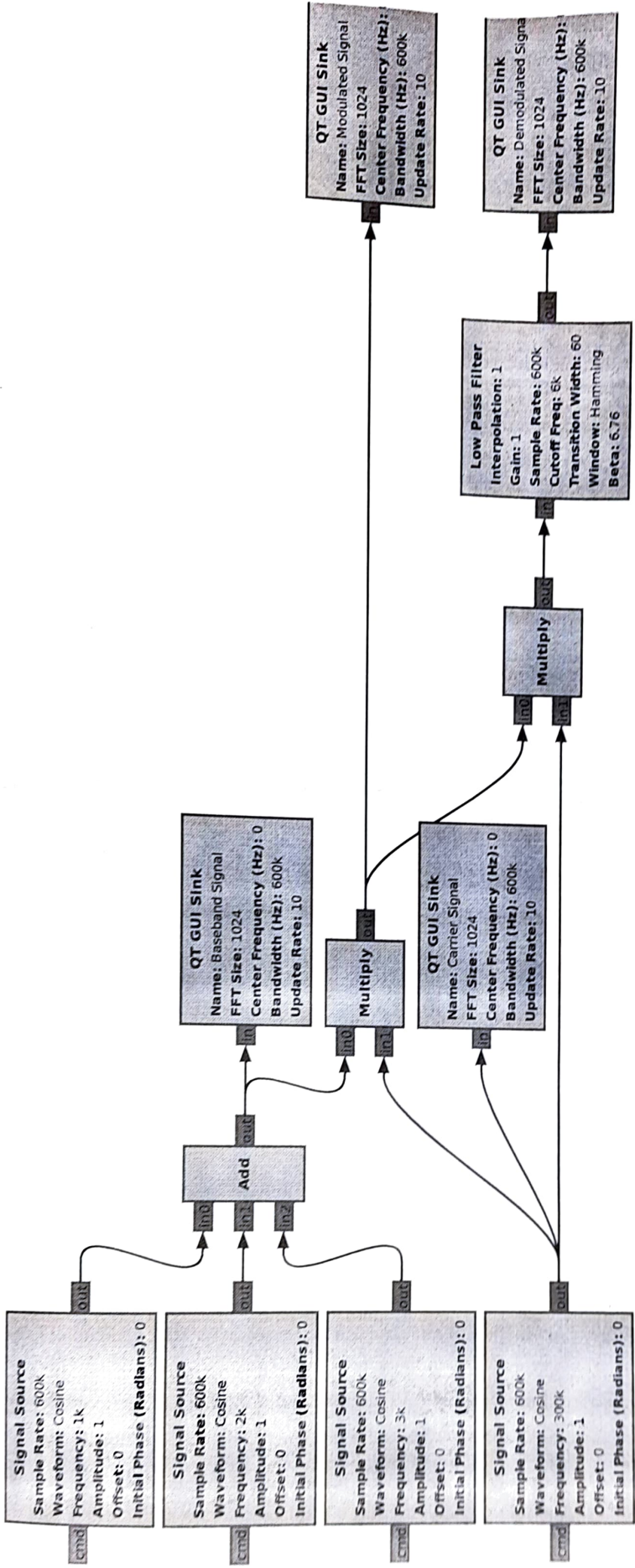
Thus, performed amplitude modulation and demodulation for the given message and carrier signals. All the simulation results were verified successfully.

Options
File: Basic_Am...Modulation
Author: Santosh
Copyright: 2022
Input Language: Python
Generate Options: QT GUI

Variable
ID: samp_rate
Value: 200k

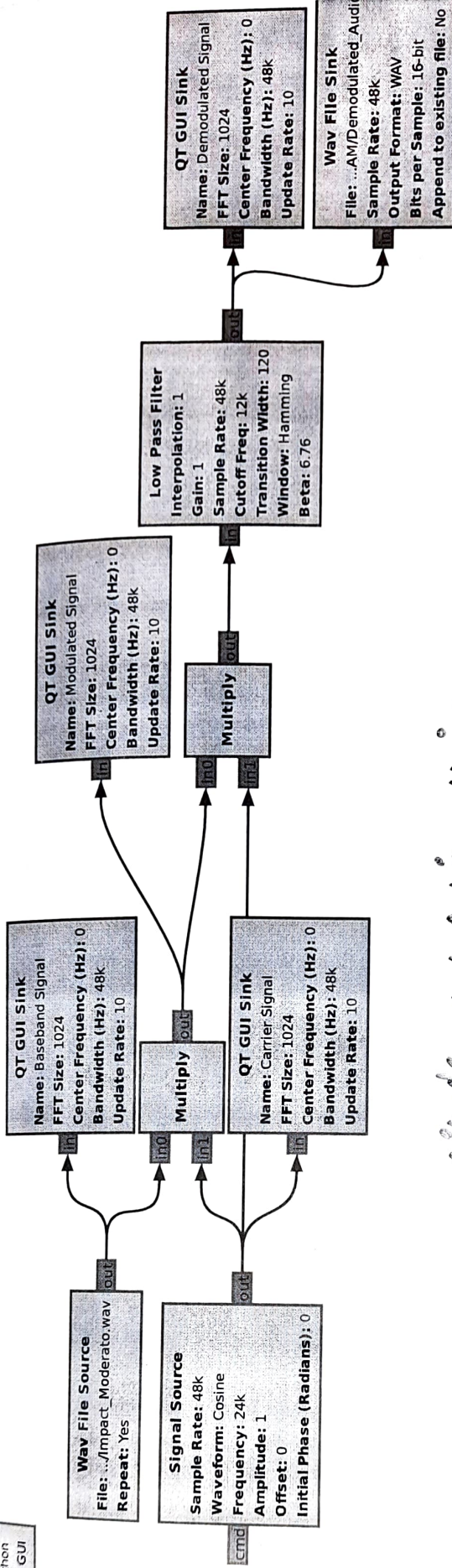


1a) Modulation and Demodulation of Single Tone Signal



b) Multitone Amplitude Modulation and Demodulation

Options
File: Amplitude...on_WAV_File
Author: Santosh
Copyright: 2022
Output Language: Python
Generate Options: QT GUI



*c. Amplitude Modulation using
Audio File*

* OUTPUTS:

A. modulation and Demodulation of single Tone signal

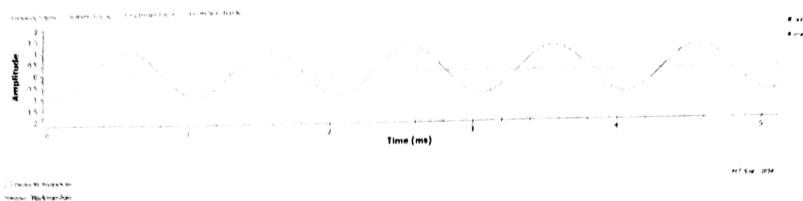


Figure 1 - message (cosine) signal

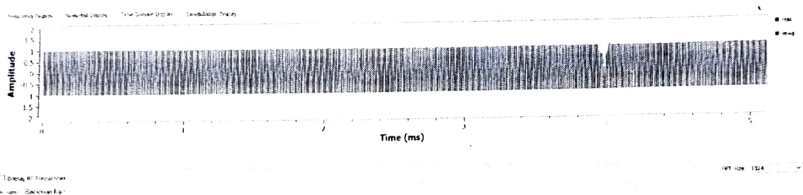


Figure 2 - carrier (cosine) signal

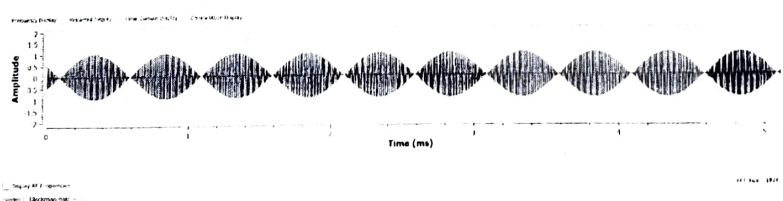


Figure 3 - Modulated signal

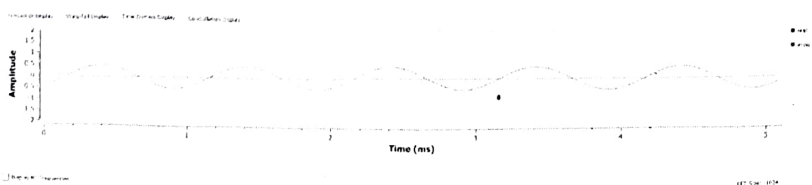


Figure 4 - Demodulated signal

8. Multitone Amplitude Modulation and Demodulation -

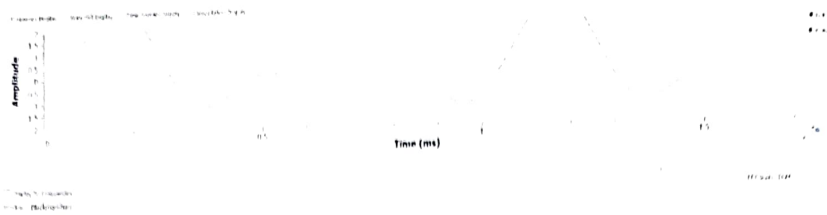


Figure 1 - message signal

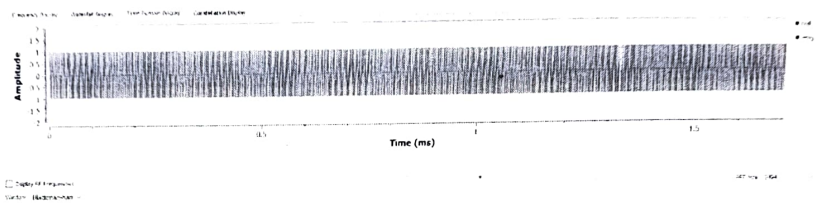


Figure 2 - carrier (cosine) signal

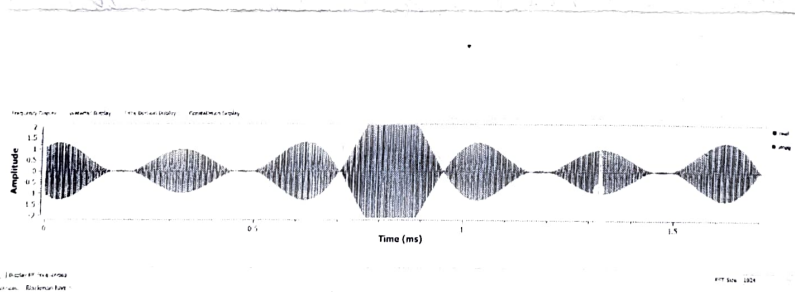


Figure 3 - Modulated Signal

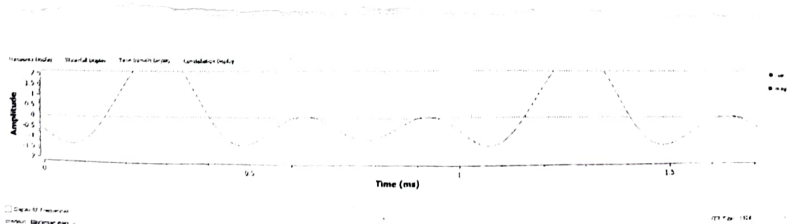


Figure 4 - Demodulated Signal

c. Amplitude Modulation using wav file -

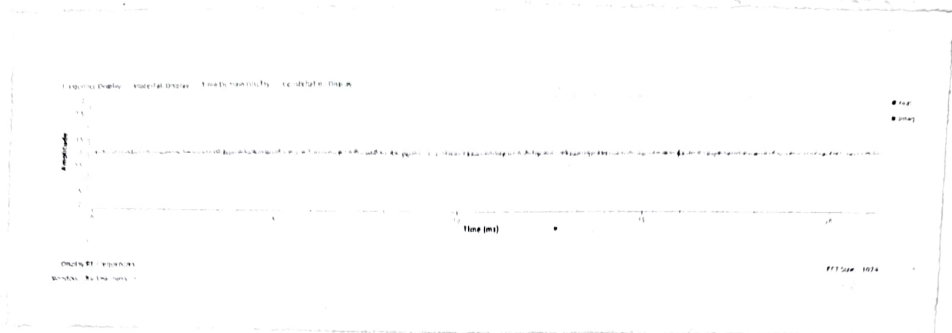


Figure 1 - Message Audio Signal

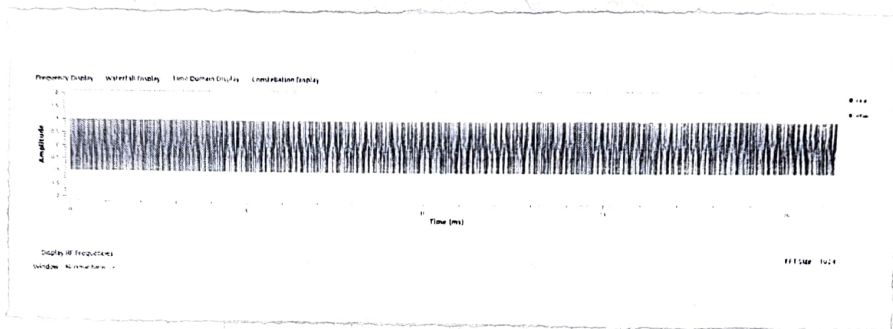


Figure 2 - Carrier (Cosine) Signal

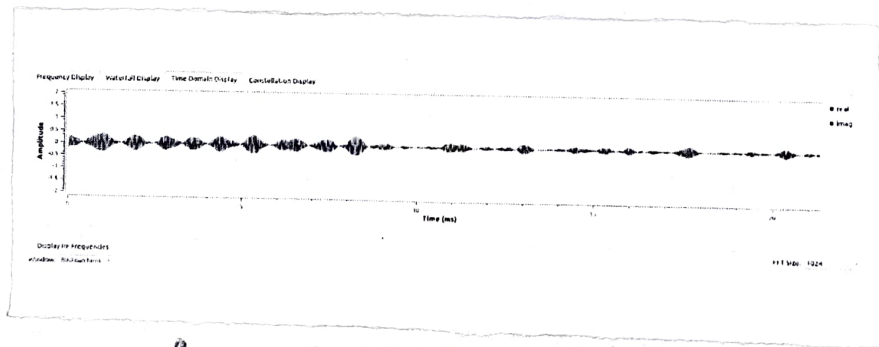


Figure 3 - Modulated Signal

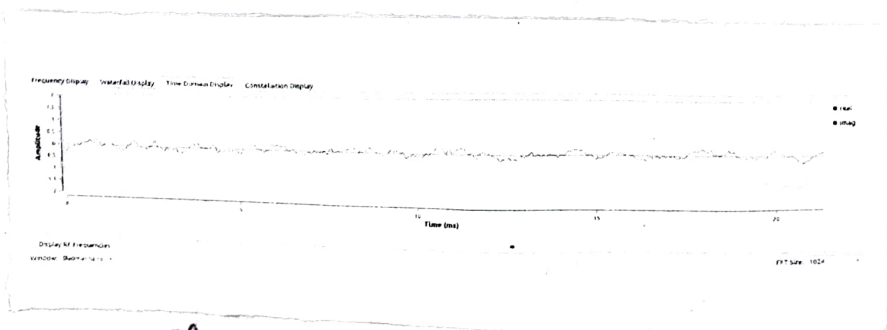


Figure 4 - Demodulated Signal