EXPERIMENT NUMBER : 4

EXPERIMENT NAME: FREQUENCY AND PHASE MODULATION

DATE : 07/11/2022, MONDAY

★ AIM:

To perform angle modulation on input signal and to verify the output that is obtained.

★ 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)

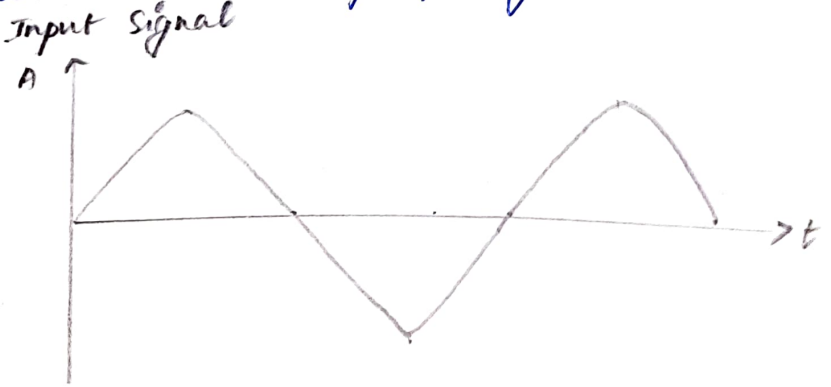
★ THEORY:

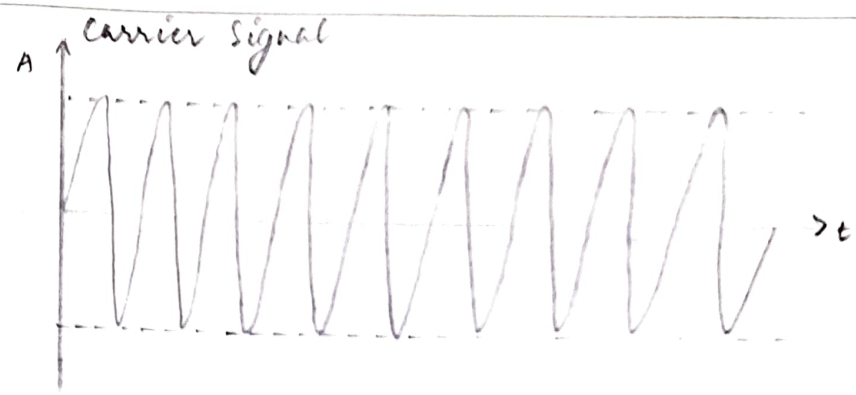
I. Angle Modulation -

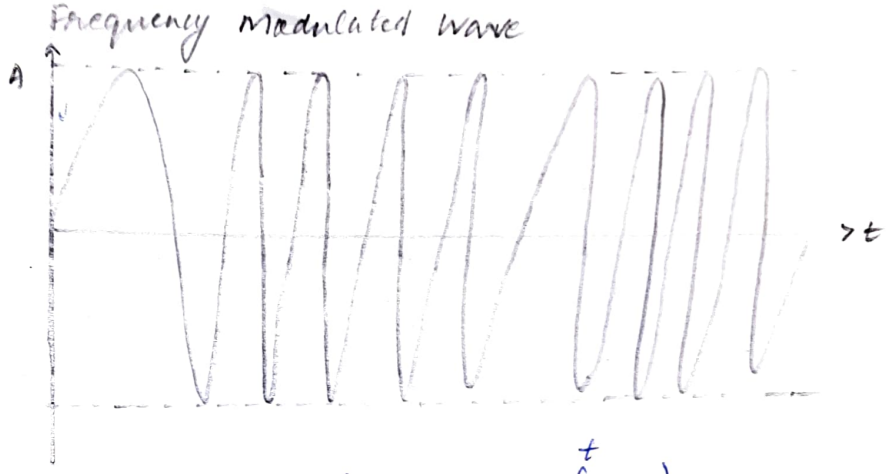
It is the process in which the frequency or phase of the carrier signal varies according to the message signal. This is further divided into frequency and phase modulation.

II. Frequency Modulation -

It is the process where frequency of the carrier signal varies in accordance with instantaneous amplitude of the modulated signal. Amplitude and phase of the signal remains constant and frequency alone varies.







$$i(t) = A_c \cos\left(2\pi f_c t + 2\pi k_f \int_0^t m(t)\right)$$

this is the equation for modulated wave where k_f is frequency modulation index.

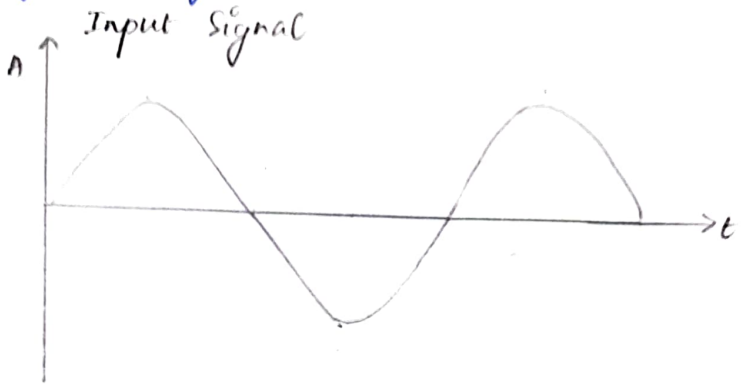
III. Narrowband FM –
(i) Modulation has small bandwidth.
(ii) Modulation index is small.
(iii) Spectrum has carrier, upper sideband and lower sideband.
(iv) Used in mobile communication.

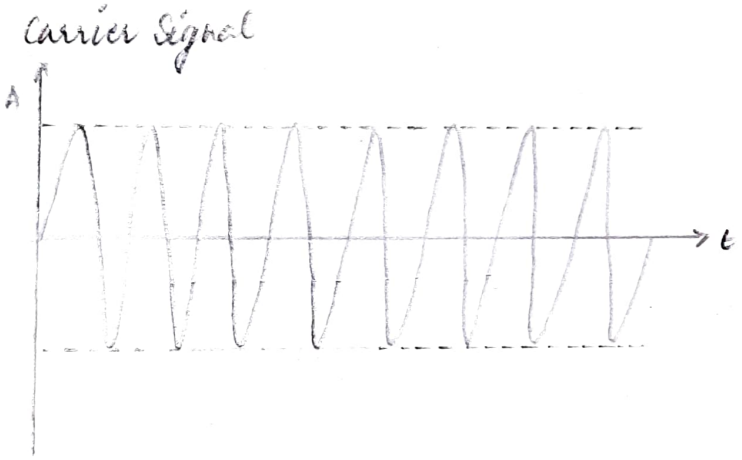
IV. Wideband FM –
(i) Modulation has infinite bandwidth.
(ii) Modulation index is large.
(iii) Spectrum has a carrier and infinite number of sideband.
(iv) Used in broadcast communication.

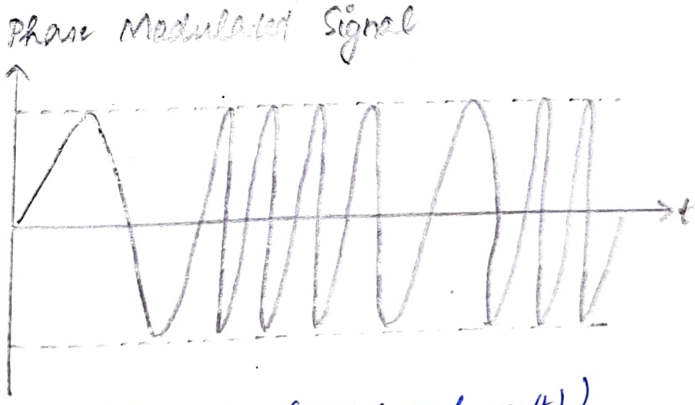
PTO

7. Phase Modulation -

It is the phase of the carrier signal that varies in accordance with the instantaneous amplitude of message signal. Amplitude and frequency remains constant.







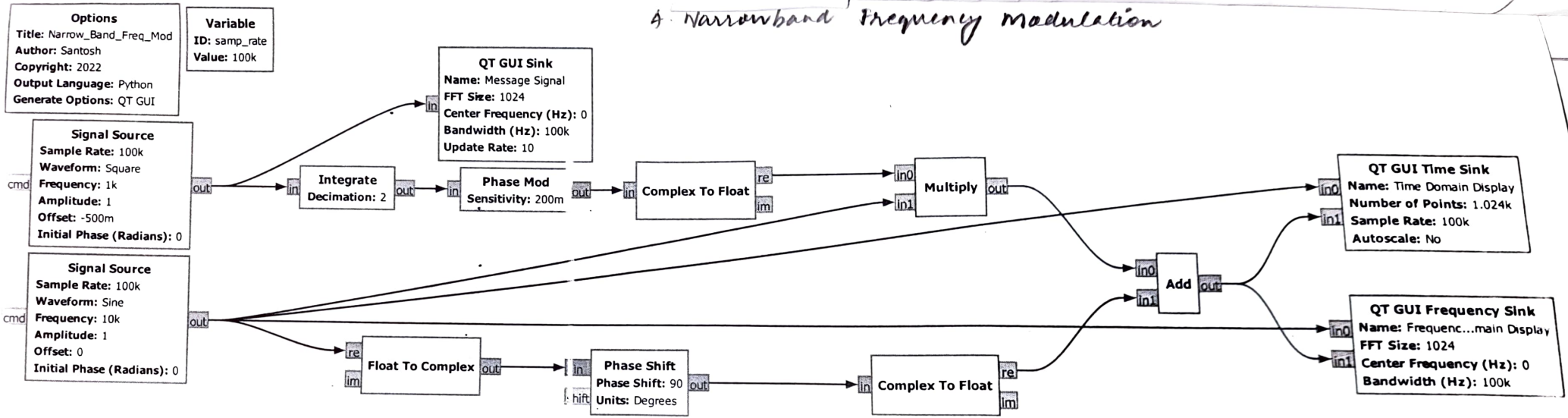
$$u(t) = A_c \cos(2\pi f_c t + k_p m(t))$$

where k_p is the phase modulation index.

* RESULT:

Thus, performed angle modulation on input signal and all the simulation results were verified successfully.

4. Narrowband Frequency Modulation



✈ OUTPUTS :

A. Narrowband Frequency Modulation –

Figure 1- Frequency Modulated Signal

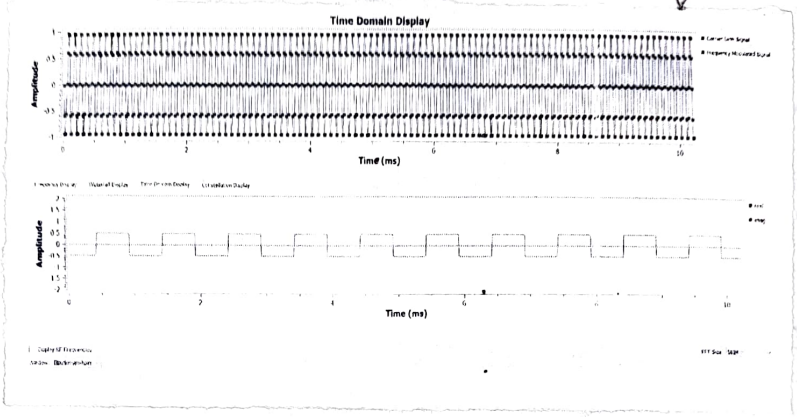


Figure 2 - carrier (Square) Signal

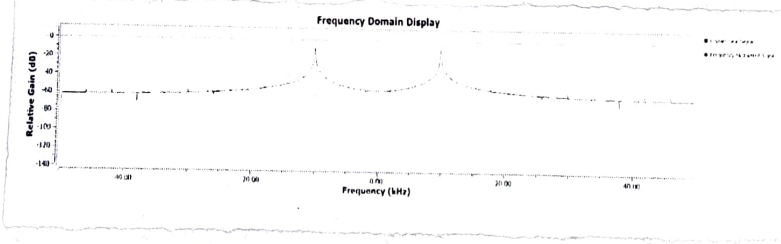
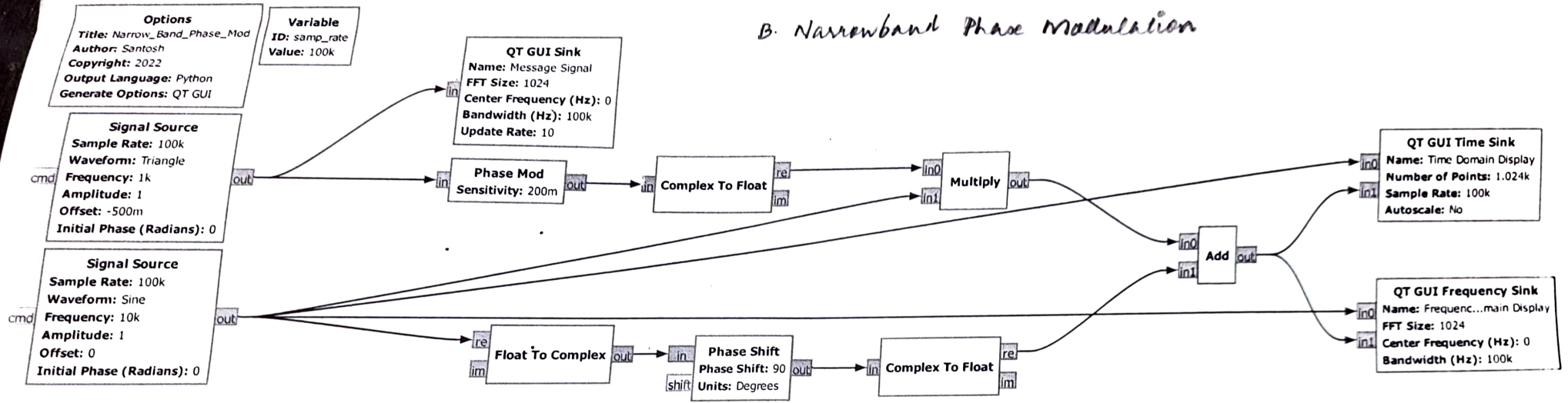


Figure 3- Frequency Domain Display

B. Narrowband Phase Modulation



6 Narrowband Phase Modulation

Figure 1 - Phase Modulated Signal

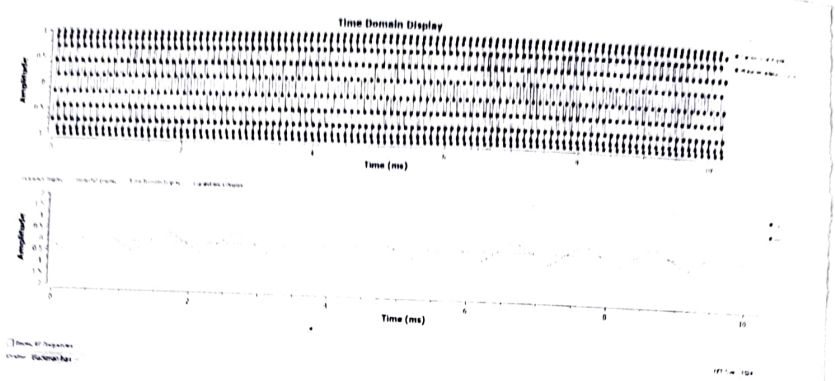


Figure 2 - Message (Triangle) Signal

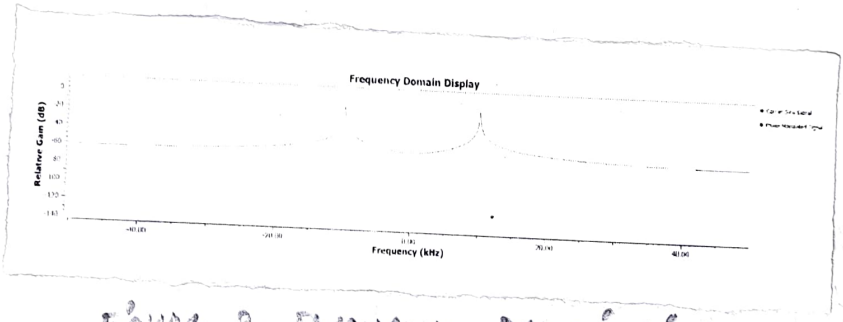


Figure 3- Frequency Domain Display