EXPERIMENT NUMBER 2

Frequency Modulation & Demodulation

AIM: To perform frequency modulation and demodulation and for various modulating voltages and plot the relevant waveforms.

EQUIPMENT REQUIRED

Equipment	Range	Quantity
CRO	(0-20)MHz	1
Function Generator	(0-1)MHz	2
Experiment Kit		1
Power Supply	+12V	1
Multimeter		

COMPONENTS REQUIRED

Components	Value	Quantity
IC	IC2206	1
IC	IC565	1
Capacitor	0.01µF	2
	1µF	2
	10µF	2
	100µF	2
	470µF	1
Resistor	10kΩ	1
	1KΩ	1
	10KΩ	1
	4.7 KΩ	2
	47 KΩ	1
	200Ω	1
	560Ω	2
Potentiometer	0-470KΩ	1

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 modulation signal. Amplitude modulation is defined as the process in which is the amplitude of the carrier wave is varied about a means values linearly with the base band signal. The envelope of the modulating 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 fm of the message signal m (t) i.e. fc >> 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.

PROCEDURE:

1. Connections are made as shown in the circuit diagram; only potentiometer is not connected initially.
2. Another end of 1K resistor is grounded and V_{cc} is set to +12V.
3. Output is observed on the display which is the carrier signal generated by the IC.
4. Note down the carrier sine wave frequency f_c of the IC.
5. Now connect the potentiometer and apply the modulating signal m(t) with suitable amplitude to get undistorted FM signal.

DESIGN PROCEDURE

Design 1:

1. **FM Modulator Circuit**

   Let carrier frequency $f_c = 3$ KHz, $f_c = 0.3/RC_t$
   Choose R = 10KΩ=R_a= R_b, then $C_t = 0.01\mu f$
   Take R_L = 10KΩ, $C_C = 0.01\mu f$

2. **Demodulator using PLL**

   Let $f_o = f_c = 3$KHz, $f_o = 1.2/4R_1C_1$
   Choose $C_1 = 0.01\mu f$, then R_1 =100 KΩ
   Filter Design: Let f_m = 1 KHz = $1/2\pi RC$
   Choose $C = 0.1\mu f$, then R = 1.59 KΩ

Design 2:

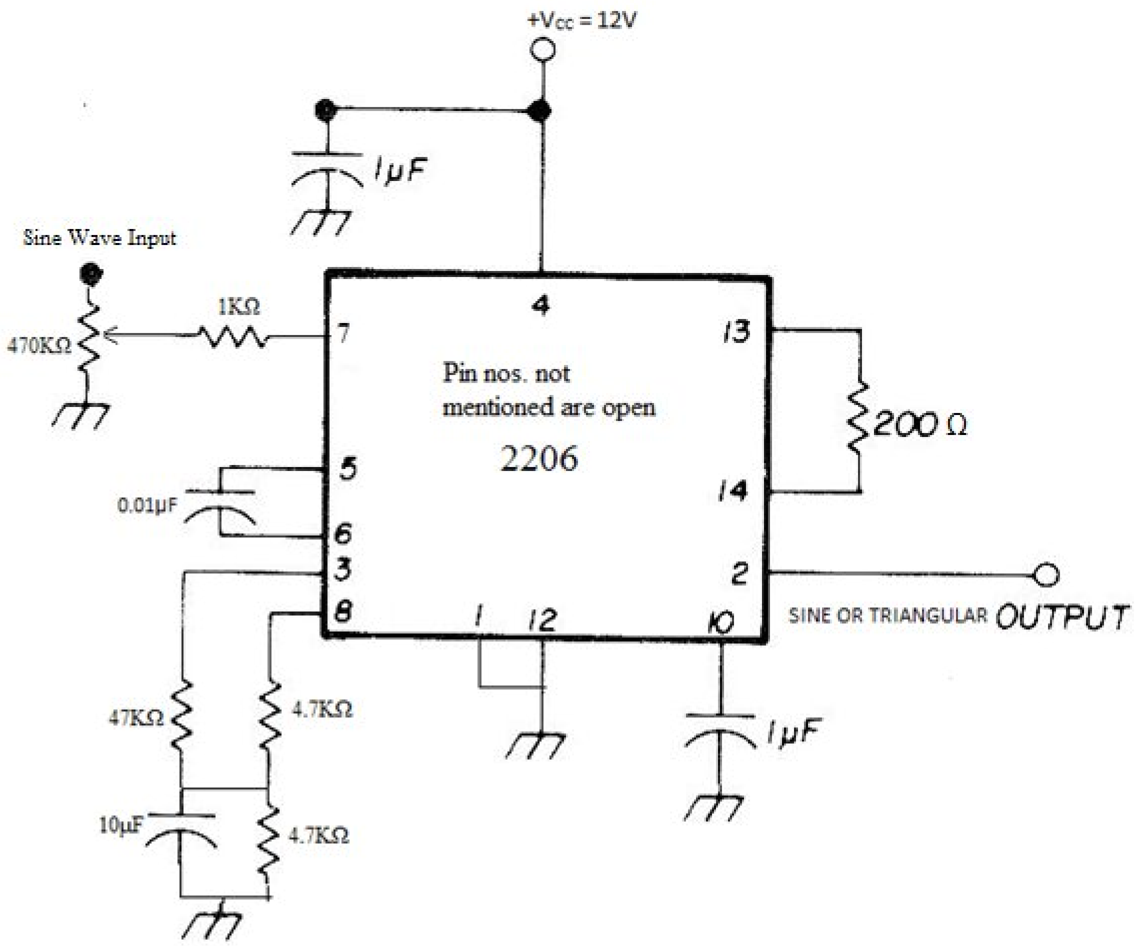
1. **FM Modulator Circuit**

   Let carrier frequency $f_c = 5$ KHz
   Choose $R = 10K\Omega = R_a = R_b$, then $C_t = 0.001\mu f$
   Take $R_L = 10K\Omega$, $C_C = 0.01\mu f$

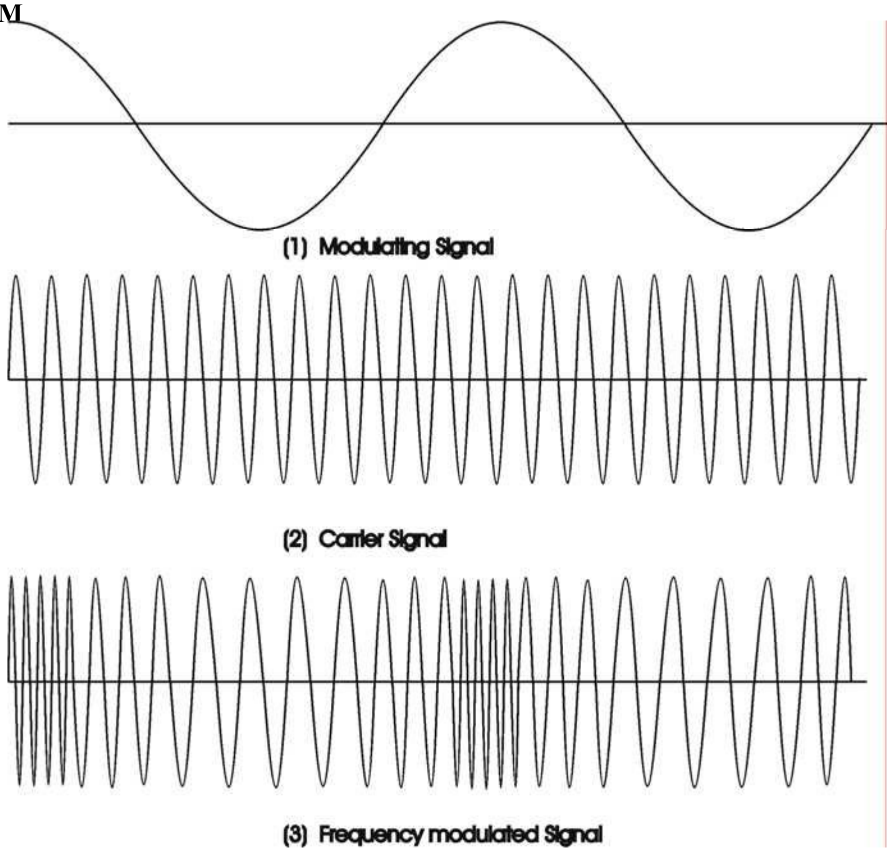
2. **Demodulator using PLL**

   Let $f_o = f_c = 3KHz$, $f_o = 1.2/4R_1C_1$
   Choose $C_1 = 0.001\mu f$, then $R_1 = 100\ K\Omega$
   Filter Design: Let $f_m = 1$ KHz $= 1/2\pi RC$
   Choose $C = 0.1\mu f$, then $R = 1.59\ K\Omega$

CIRCUIT DIAGRAM



WAVEFORM



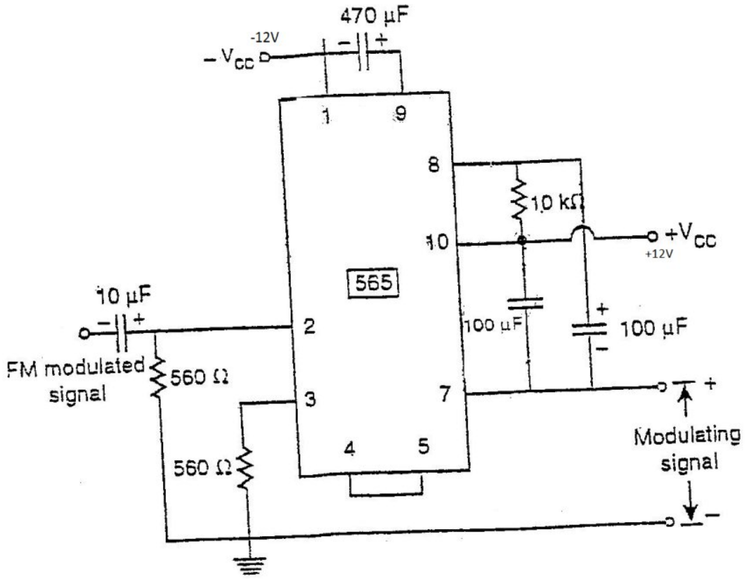
Frequency Demodulation

The process of detection provides a means of recovering the modulating Signal from demodulating signal. Demodulation is the reverse process of modulation. The 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.

PROCEDURE

1. Connections are made as shown in the circuit diagram.
2. Now $-V_{cc}$ is set to -12V and and $+V_{cc}$ is set to +12V.
3. The frequency modulated signal is given as input to the demodulation circuit.
4. The demodulated output is observed on the display.
5. Various values of modulating voltage signal frequency corresponding to demodulated voltage and frequency are noted and the readings are compared (both must be same in all parameters).

CIRCUIT DIAGRAM



Demodulated Waveform