Experiment No: 05
Experiment Date:06.11.2022
Experiment Name: Study of Frequency Modulation and Demodulation

Theory:
Modulation is nothing but a process of modulating two signals, one of them is the main signal that we want to transfer and another one is the carrier signal which has high frequency and amplitude.As we are substituting the main signal upon carrier the amplitude and frequency got changed thats why its called modulation.Modulation is very important. It helps to spare the signal from different transmitters, helps to reduce the antenna height, and helps to transmit the signal over a long distance without any interface.There are 3 types of analog modulation. These are:
1. Amplitude Modulation
2. Frequency Modulation
3. Phase Modulation

Frequency modulation is a technique or a process of encoding information on a particular signal (analogue or digital) by varying the carrier wave frequency in accordance with the frequency of the modulating signal. As we know, a modulating signal is nothing but information or message that has to be transmitted after being converted into an electronic signal.
It can be represented mathematically as;
$vm = Vm \cos(\omega mt)$ …… 1
Where,
Vm is Amplitude of the massage signal.
ωm is the Angular frequency of the message signal.

Such as amplitude modulation, when we try to modulate an input signal (information), we need a carrier wave, we will experience
$vc = Vc \sin(\omega ct)$ …….. 2

Then frequency modulated wave will be;
$f = fc(1+kVm)$
$f = fc(1+ kVm\cos(\omega mt))$ …….. 3
Or, $f = fc(1+kVm)$

Now,the process of separating the original information or SIGNAL from the modulated carrier is called demodulation.
So,for doing this frequency modulation first we have to generate the carrier signal and message signal.Here we have a device named DSB AM reception. Where it generates frequency

modulation signal or message signal and a local oscillator which generates a high frequency signal which is nothing but carrier signal.Then we pass this who signal into a mixer which will add two signal frequency and this is the modulated signal.This is how we can do the modulation process.

Now for demodulation we have to pass this modulated signal in some of the circuits.First we pass the modulated signal in a limiter circuit.Limiter circuit is nothing but a circuit that only allow to pass a fixed level of a signal.We can keep it as 5V or 10V as we want.There are two types of limiter:

1. Soft limiter-Which less the gain but keep the shape good.
2. Hard limiter-Which will not allow to pass the signal after a fixed value like 5V.It will not pass the signal over 5V.

After passing the signal limiter circuit then we use a Foster-Seeley Detector circuit.This is a frequency sensing circuit that will fix the amplitude.

Then we pass the signal low pass filter which will remove noise and distorttion.As noise and distortion is high voltage so after passing the output of Foster-Seeley Detector in low pass detector circuit we will get a good output which is the demodulated signal.This is how we do the process of demodulation.

Circuit Diagram:

This is the input circuit that generates massage and carrier signals and does the work of modulation.Output of this circuit is modulated signal.

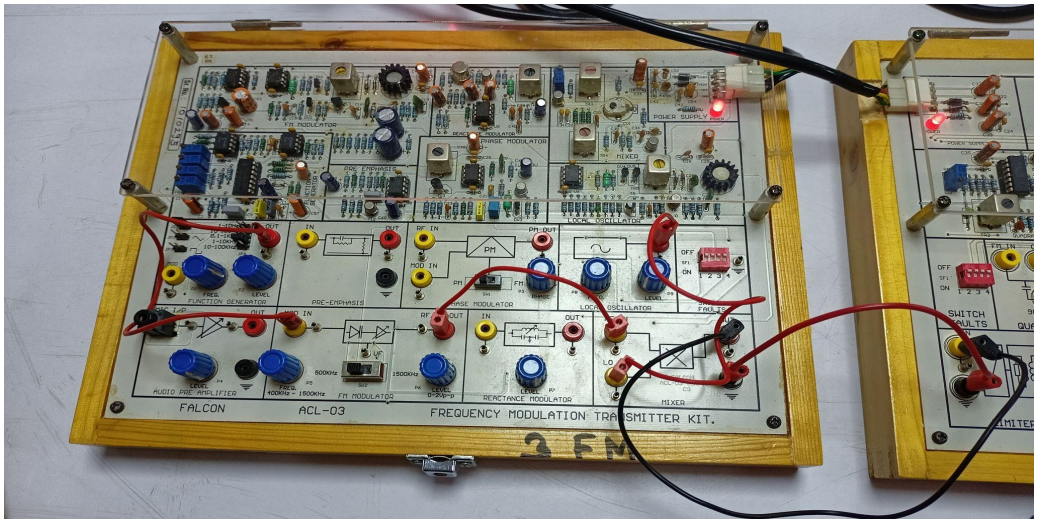

Figure 01: Input Circuit

This is the circuit that takes modulated signal as input in the limiter then passes it through Foster-Seely circuit then low pass filter.Output of this circuit is demodulated signal.

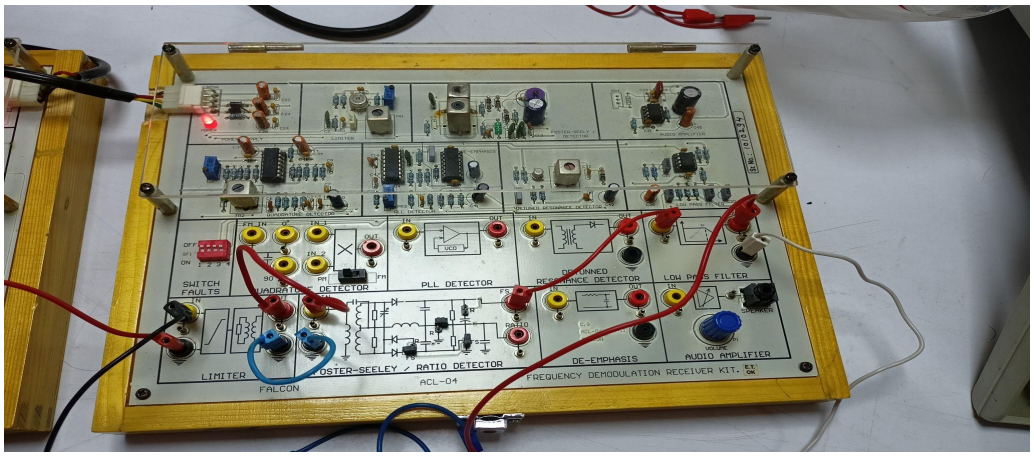

Figure 02: Output Circuit

Output:

This is the input signal or message signal

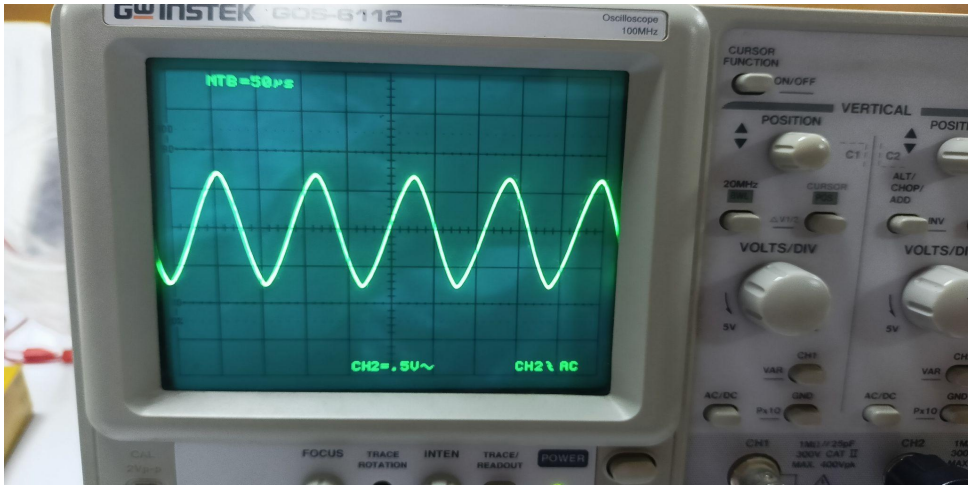

Figure 03: Input Signal(message signal)

After modulation the process output will look like this.

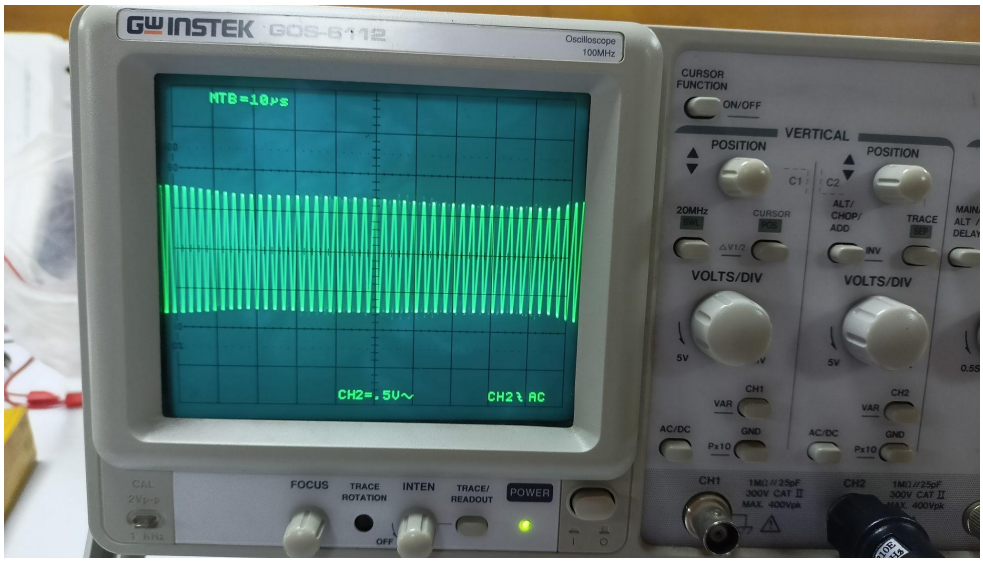

Figure 04: Modulated signal

First modulated signal is passed through the limiter then Foster-Seely circuit then the output looks like this.

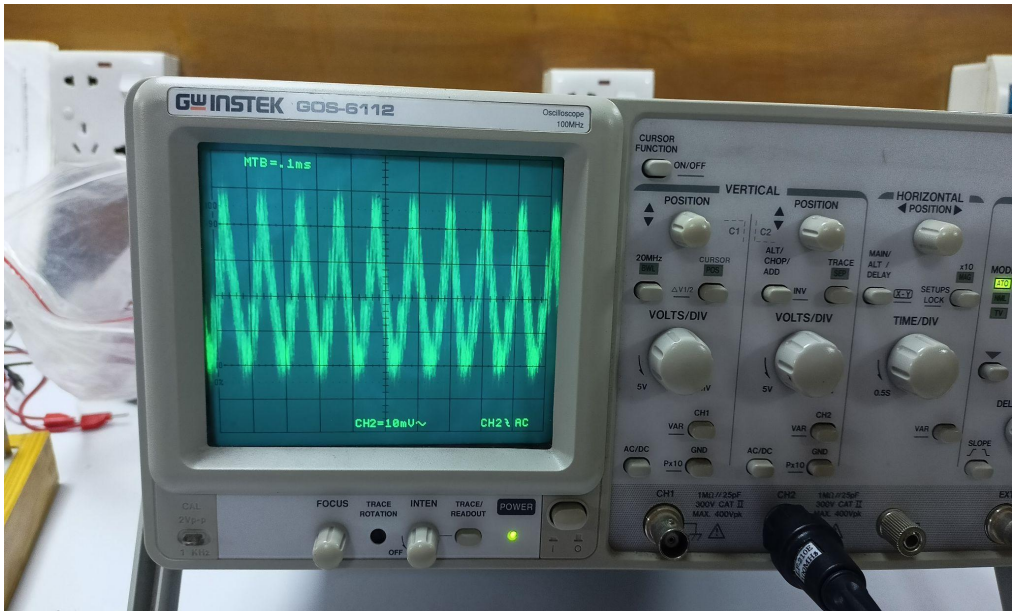

Figure 05: Output of Foster-Seeley Circuit

This is the final output of the demodulation signal which is getting after passing the signal in a low pass filter.

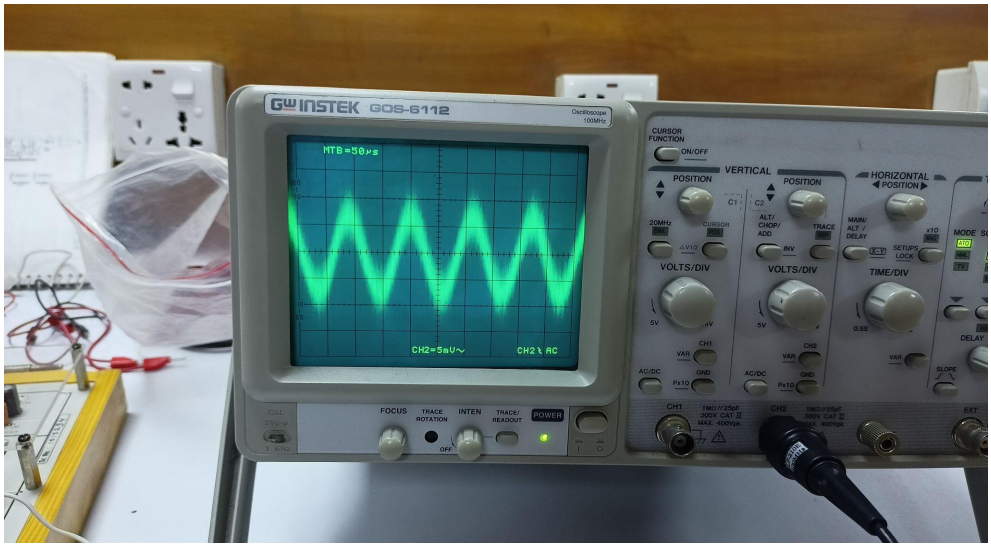

Figure 06: Output of low pass filter(Demodulated signal)

Discussion:

As we know from the theory that modulation is nothing but mixing of two signal.So in this experiment, we have simulated two signals and and after modulating we get the modulated signal which is a combination of massage signal and carrier signal.Normally in real life the main signal or message signal is weak so we have taken the message as a weak signal. On the other hand, a strong signal has also been taken as a carrier signal to transmit the message signal as we have to send the signal a long way which is the main thing of modulation.For doing this modulation first we have generated a message signal and carrier signal is automatically generated.After passing this in mixer we get the modulated signal.

After doing modulation for the demodulation process we first pass the modulated signal in a limiter circuit.Then we pass the signal in Foster-Seeley Detector circuit for getting fixed value of signal.We connected the Foster-Seeley circuit by short FS in the circuit board.Then this signal is pass through low pass filter for better output.Then we will get the demodulated signal.

Conclusion:

In this experiment we have successfully learned the process of frequency modulation and demodulation.After doing the modulation we can see the theoretical knowledge about frequency modulation is matched practically through simulation.The modulated signal which is output of mixer was pretty good but the demodulated signal was distorted.As we are using low pass filter for better output but we rather get good output in Foster-Seeley Detector which is not desirable.