Analog Communications Lab-20EC56

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B.Tech. (IV Sem.) 20EC56 - ANALOG COMMUNICATIONS LAB

List of Experiments

PART-A

1. Generate the Amplitude modulated (AM) signal for different modulation indices and reconstruct the original signal.
2. Demonstrate the generation of Frequency modulated signal and reconstruction of original signal.
3. Use product modulator to generate double sideband suppressed carrier AM signal and demodulate the signal using Synchronous detector.
4. Apply phase shift method for generating the Single sideband modulated AM signal and demodulate using coherent detector.
5. Estimate the cutoff frequencies for Pre emphasis and De-emphasis circuits.
6. Generate the Pulse Amplitude Modulated signal and reconstruct the original signal using low pass filter
7. Construct circuits for generating the Pulse width and Pulse position modulated signals using IC555 and perform demodulation to reconstruct the message signal
8. Generation of sampled signal for different sampling rates and verify sampling theorem for efficient reconstruction.

PART-B (Simulation Using MATLAB)

9. Amplitude Modulation and Demodulation.
10. Frequency Modulation and Demodulation.
11. Pulse Amplitude Modulation and Demodulation.
12. Pulse Time Modulation and Demodulation.

Experiments Beyond syllabus

1. Construct a signal flow graph for generating Amplitude modulated Signal using GNU Radio
2. Construct a signal flow graph for generating Frequency modulated Signal using GNU Radio.

PART-A

Generate the Amplitude modulated (AM) signal for different modulation indices and reconstruct	EXP NO.1
	DATE :

1. AIM:

1. To generate amplitude modulated signal for different modulation indices.
2. To demodulate the Amplitude modulated wave.

2. COMPONENTS & TOOLS REQUIRED:

1. Amplitude Modulator Trainer Kit
2. Cathode Ray Oscilloscope (30 MHz).
3. CRO Probes
4. Patch Cords

3. THEORY:

Modulation is defined as process in which changing the amplitude, frequency and phase of high frequency wave (Carrier wave) by using instantaneous values of the low frequency signal (modulating signal).Antenna height and operating frequencies are related each other. So antenna heights are comparable to the quarter wavelengths. For usual audio frequencies antenna heights are unthinkable and impracticable. Hence modulation is used to frequency translate the message signal to send over longer distances. Amplitude modulation is defined as the process in which changing the amplitude of the Carrier wave by using the instantaneous voltages of the modulating signal. In this carrier signal frequency remains constant.

Let the modulating signal be, $m(t)=A_m\cos(2\pi f_m t)$ and the carrier signal be, $c(t)=A_c\cos(2\pi f_c t)$

The standard form of an Amplitude modulated wave is given as

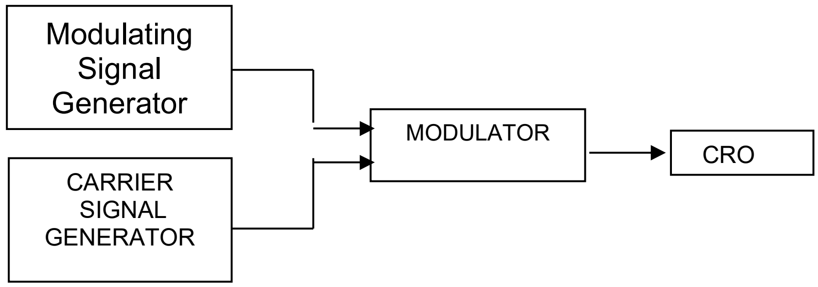
$$s(t) = A_c[1 + k_a m(t)]\cos(2\pi f_c t)$$

where K_a is a constant called the amplitude sensitivity of the modulator or modulation index.

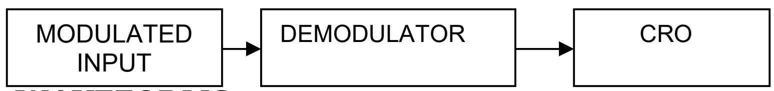
The demodulation circuit is used to recover the message signal from the incoming AM wave at the receiver. An envelope detector is a simple and yet highly effective device that is well suited for the demodulation of AM wave, for which the percentage modulation is less than 100%. Ideally, an envelop detector produces an output signal that follows the envelop of the input signal wave form exactly; hence, the name. Some version of this circuit is used in almost all commercial AM radio receivers.

4. BLOCK DIAGRAM:

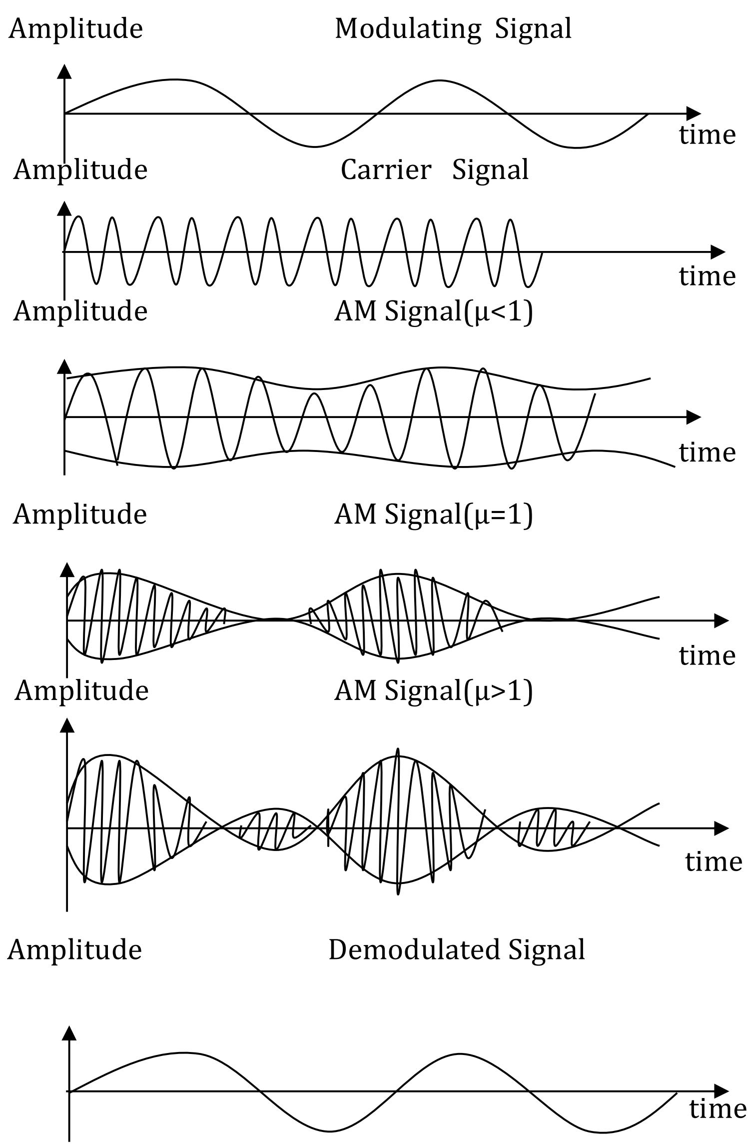
MODULATOR



DEMODULATOR:



5. MODEL WAVEFORMS:



6. EXPERIMENTAL PROCEDURE:

1. Switch on the power supply through mains card.
2. Observe the modulating signal on CRO and set the modulating voltage to 2 V and frequency to 1.56 KHz.
3. Observe the carrier signal on CRO and set the carrier voltage to 2.6 V and frequency to 166.66 KHz.
4. Connect the carrier and modulating signal's to modulator and also connect the output of modulator to CRO and note down the waveforms.
5. Find out the maximum and minimum voltages from CRO and from these values

   Calculate modulation index by using the above formula.

$$\mu = \frac{A_{max} - A_{min}}{A_{max} + A_{min}}$$

6. Repeating the above procedure for different modulation index and draw the waveforms.
7. Connect the amplitude modulated signal to the demodulator
8. Connect the CRO across the output terminals of the demodulator
9. Observe and note down the waveforms of the modulating signal for the condition μ <1.

7. PRECAUTIONS:

1. Check for loose contacts of wires and components.
2. Keep all the control knobs in the minimum position.
3. Before switch on the power supply get the circuit connections verified by the teacher.
4. Adjust the control knobs smoothly.
5. After taking the readings bring back all the control knobs to minimum position.
6. Switch off the power supply before leaving the experimental table.

8. OBSERVATIONS:

Under modulation (All voltages are peak to peak)

Modulating signal :

Amplitude :

Time period :

Frequency :

Carrier signal :

Amplitude :

Time period :

Frequency :

Modulated signal:

A_{max} :

A_{min} :

Modulation index **:**

Demodulated signal:

Amplitude :

Frequency :

Critical modulation:

Modulating signal:

Amplitude :

Time period :

Frequency :

Carrier signal:

Amplitude :

Time period :

Frequency :

Modulated signal:

A_{max} :

A_{min} :

Modulation index:

Over modulation :

Modulating signal :

Amplitude :

Time period :

Frequency :

Carrier signal:

Amplitude :

Time period :

Frequency :

Modulated signal:

A_{max} :

A_{min} :

Modulation index :

9. RESULT:

Amplitude modulated wave is generated at different modulation indices and demodulated the signal

10. VIVA -VOCE QUESTIONS:

1. What is modulation?
2. Define modulation index?
3. What is the condition for over modulation?
4. In modulation, what parameters of the high frequency signal are varied?
5. What are the basic types of modulation techniques?

Demonstrate the generation of Frequency modulated signal and reconstruction of original signal	EXPT. NO : 2
	DATE :

1. AIM:

1.To generate frequency modulated (FM) wave and determine modulation index.

2. To demodulated the FM wave.

2. COMPONENTS & TOOLS REQUIRED:

1. Frequency modulator Trainer Kit
2. Cathode ray oscilloscope (30 MHz).
3. CRO probes
4. Patch Cords

3. THEORY:

FM Modulation is a non-linear modulation technique. In FM the frequency of carrier is varied in accordance with amplitude of modulating signal (AF signal). But amplitude is maintained constant. Since the variation in phase angular term it is comes under angle modulation scheme, the most important feature of FM modulation is that it can be provide better discrimination against noise and interference than AM. The disadvantage of FM is it requires more transmission bandwidth than AM. The FM signal is expressed

$$s(t) = A_c \cos(2\pi f_c t + \beta \sin(2\pi f_m t))$$

Where A_c is amplitude of the carrier signal, f_C is the carrier frequency and β is the modulation index of the FM wave.

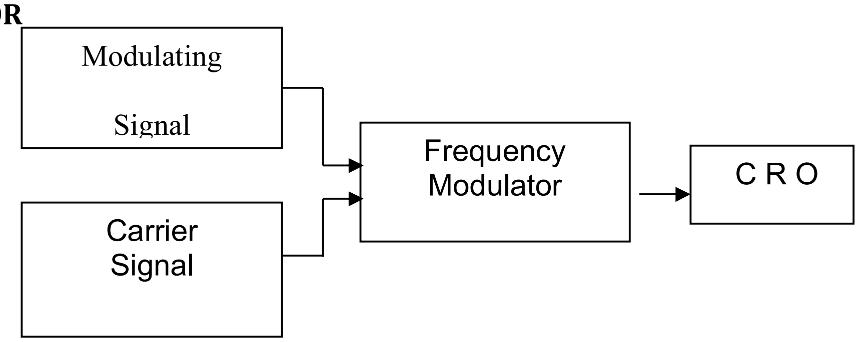
. The ratio of max frequency deviation to modulating frequency defines as modulation index, which is given by $\boldsymbol{\beta} = \frac{\Delta f}{f_m}$

where Δf is called as frequency deviation and f_m is called as frequency of modulating signal. $\Delta f = K_f A_m$ .The quantity K_f represents frequency sensitivity of modulator and A_m represents amplitude of the message signal.

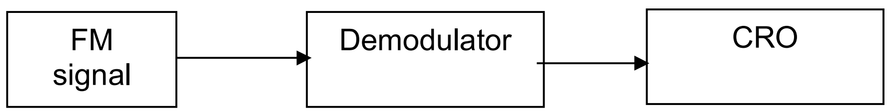
If Modulation index is less than one then the modulated wave is called Narrow Band FM signal. If Modulation index is greater than one then the modulated wave is called Wide Band FM signal.

4. BLOCK DIAGRAM:

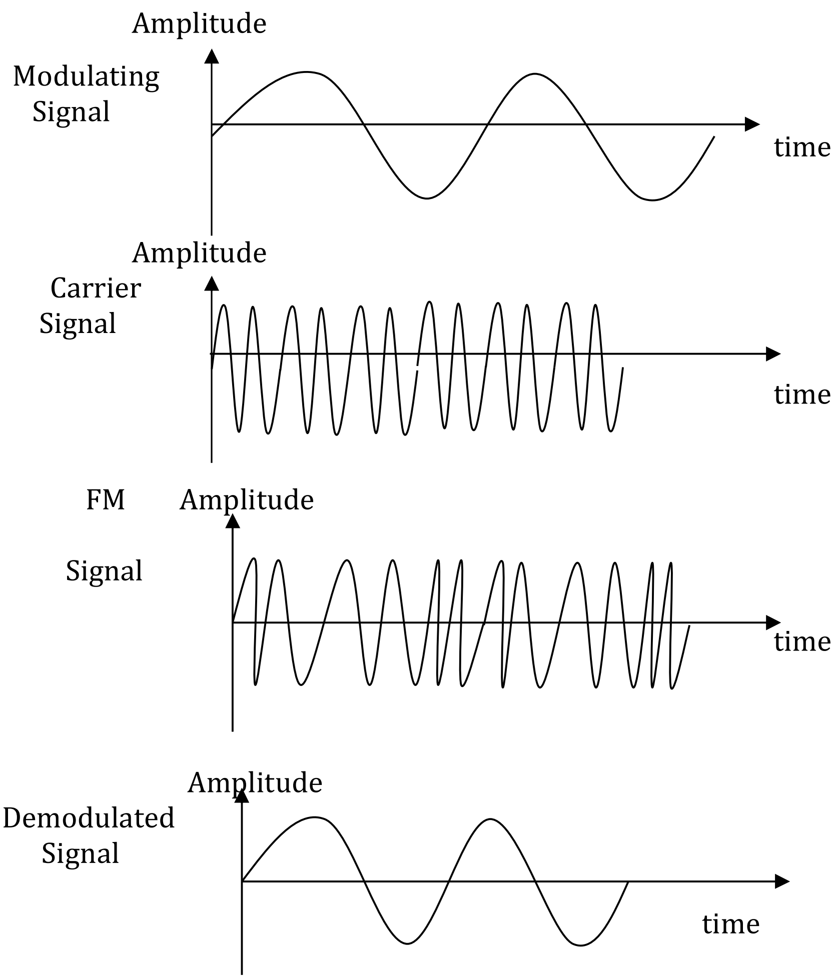
MODULATOR



DEMODULATOR:



5. MODEL WAVEFORMS:



6. EXPERIMENTAL PROCEDURE:

1. Switch on the power supply through mains card.
2. Observe the modulating signal in CRO and set the modulating voltage to 1.2 V and frequency 10 KHz note down these values. (Here the carrier is internally generated signal).
3. Connect the modulating signal to modulator also connect the output of modulator to CRO and note down the waveforms.
4. Find out the maximum and minimum frequency of frequency modulated wave from CRO and note down these values, from these values calculate modulation index by using the formula

$$\boldsymbol{\beta = \frac{\Delta f}{f_m}}$$

5. Connect the frequency-modulated signal to the demodulator.
6. Connect the CRO across the output terminals of the demodulator.
7. Observe the waveform of the modulating signal for different modulating indices

7. PRECAUTIONS:

1. Check for loose contacts of wires and components.
2. Keep all the control knobs in the minimum position.
3. Before switch on the power supply get the circuit connections verified by the teacher.
4. Adjust the control knobs smoothly.
5. After taking the readings bring back all the control knobs to minimum position.
6. Switch off the power supply before leaving the experimental table.

8. OBSERVATIONS:

Modulating signal :

Amplitude :

Time period :

Frequency :

Carrier signal :

Amplitude :

Time period :

Frequency :

Modulated signal:

T_{min} :

f_{max} :

T_{max} :

f_{min} :

Frequency deviation :

Modulation index :

Demodulated Signal

Amplitude:

Frequency:

9. RESULT:

Frequency modulated wave is generated, modulation index is determined and demodulated the FM signal.

10. VIVA -VOCE QUESTIONS:

1. What is frequency modulation?
2. How the FM can be differentiated from the frequency translation?
3. In Frequency modulated waveform where does the message signal exist?
4. What is the bandwidth required for NBFM?
5. Mention the reason for calling FM is nonlinear modulation.

Use product modulator to generate double sideband Suppressed carrier AM signal and demodulate the signal using Synchronous detector	EXPT. NO : 3
	DATE :

1. AIM:

1. To generate Double sideband suppressed carrier amplitude modulated wave using product modulator
2. To demodulate the Double sideband suppressed carrier amplitude modulated signal using Synchronous detector.

2. COMPONENTS & TOOLS REQUIRED:

1. DSB-SC Amplitude Modulator Trainer Kit
2. Cathode Ray Oscilloscope (30 MHz).
3 . CRO Probes
4. Patch Cords

3. THEORY:

Modulation:

A normal system also termed as Double Sideband Full Carrier (DSB-FC) system, transmits carrier along with the two sidebands. Hence, in Amplitude modulation, there is wastage of power due to the presence of carrier signal that does not carry any information. An AM signal with carrier suppressed is called as double sideband suppressed carrier Amplitude modulated (DSBSC-AM) signal the expression for DSBSC signal is given as

$$S(t)=A_C \cos\omega_C t \, m(t)$$

where m(t) is the modulating signal. As the output is the product of two input signals, the device used for generation of DSBSC signal is called as product modulator. Since the carrier does not convey any information, transmitting the carrier along with side band is only wasting of transmission power, therefore carrier is suppressed before transmission. By doing suppression 67% of transmission power can be saved. The method of transmission of modulated wave without carrier is DSBSC signal. DSB-SC is generated by using a product modulator using which the message signal is multiplied by a carrier signal.

Demodulation:

The demodulation of DSBSC signal is done by using Coherent or synchronous detection. That involves multiplying the DSB-SC signal with the carrier signal (with the same phase as in the modulation process) in a device called as product modulator. This resultant signal is then passed through a low pass filter to produce a scaled version of the original message signal.

4. BLOCK DIAGRAM:

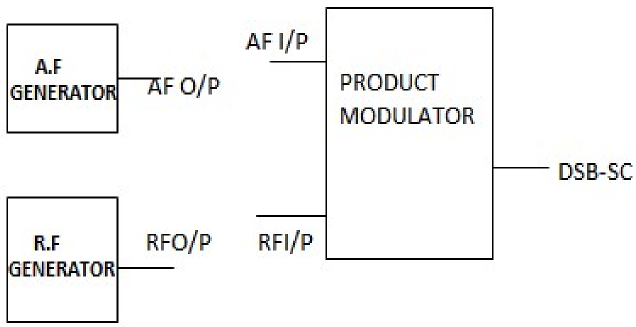


Fig.1 DSBSC signal generation

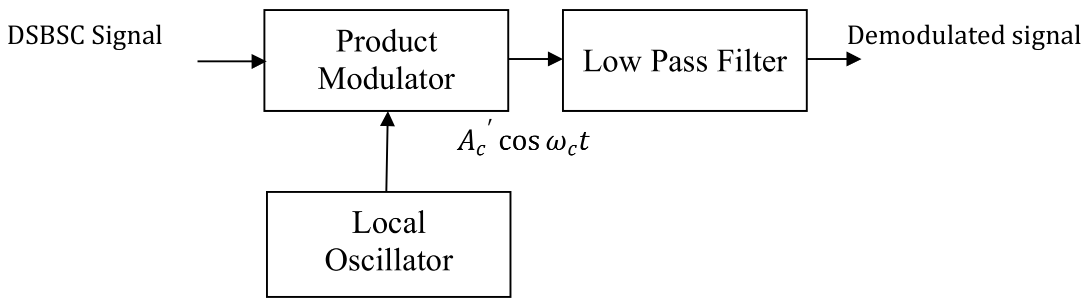
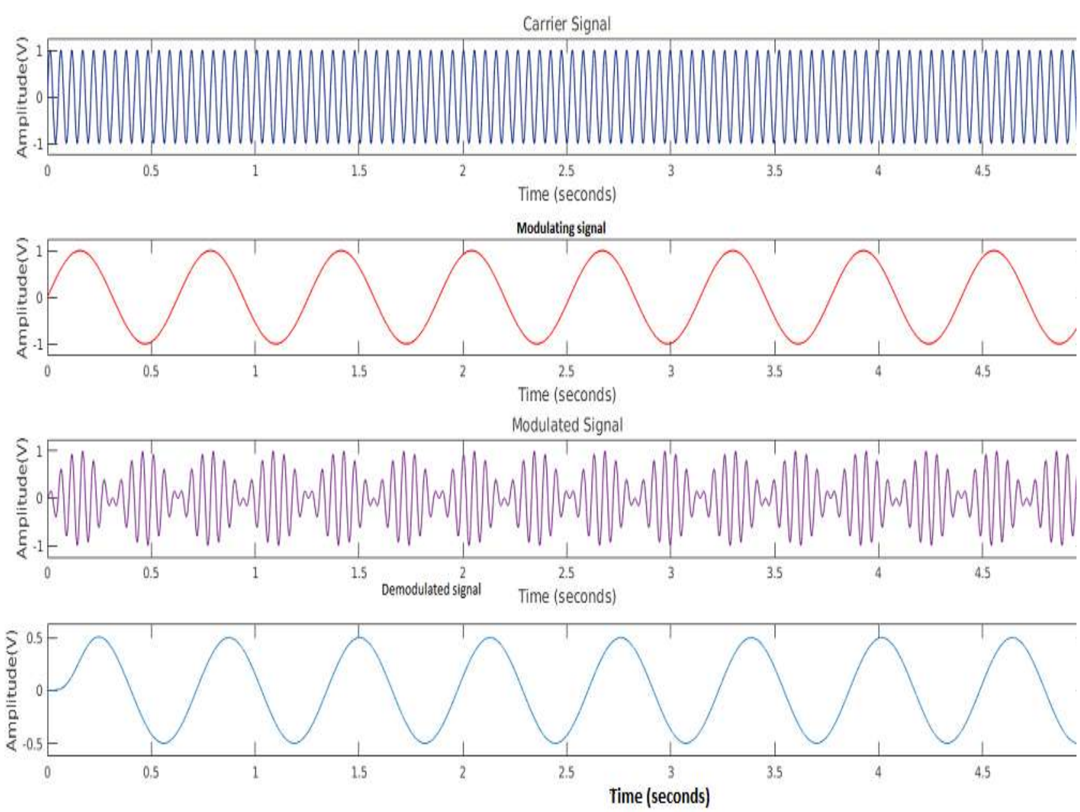


Fig.2 Demodulation of DSBSC signal using Synchronous detection

5. MODEL WAVEFORMS:



6. EXPERIMENTAL PROCEDURE:

1.Switch on the power supply through mains card.

2. Apply a 62KHz, 5V – peak sinusoidal wave to the carrier input and a 4KHz sinusoidal wave with 4V peak to the modulation input.

. 3. Observe the DSB-SC signal. Note down the DSBSC AM signal.

4. Give the modulated output as the one input to synchronous detector and carrier as other input..

5.Note down the output of synchronous detector, which is the modulating signal.

7. PRECAUTIONS:

1.Check for loose contacts of wires and components.

2.Keep all the control knobs in the minimum position.

3.Before switch on the power supply get the circuit connections verified by the teacher.

4.Adjust the control knobs smoothly.

5.After taking the readings bring back all the control knobs to minimum position.

6.Switch off the power supply before leaving the experimental table.

8. OBSERVATIONS:

Amplitude of modulating signal :

Frequency of modulating signal :

Amplitude of carrier signal :

Frequency of carrier signal :

Frequency of Balanced modulator output signal:

Amplitude of modulated signal :

Amplitude of Demodulated signal :

Frequency of Demodulated signal :

9. RESULT:

Double sideband suppressed carrier signal is generated using balance modulator and demodulated using synchronous detector

10. VIVA -VOCE QUESTIONS:

1) What is the significance of the balanced modulator?
2) What is the disadvantage of DSB-FC?
3) What is the percentage of power saving in DSB-SC over DSB-FC?
4) What is the bandwidth required for the transmission of DSB-SC signals?
5) Which detector is used for detecting the DSB-SC signals?

Apply phase shift method for generating the Single sideband modulated AM signal and demodulate using coherent detector	EXPT. NO : 4
	DATE :

1. AIM: i).To generate Single sideband modulated AM signal by applying phase shift method.

ii).To demodulate the Single sideband amplitude modulated signal using coherent detector.

2. COMPONENTS & TOOLS REQUIRED:

1. SSB Amplitude Modulator Trainer Kit
2. Cathode Ray Oscilloscope (30 MHz).
3. CRO Probes
4. Patch Cords

3. THEORY:

AM amplitude modulation produces a signal with power concentrated at the carrier frequency and two adjacent sidebands. Each sideband is equal in bandwidth to that of the modulating signal, and is a mirror image of the other. Since two side bands having the same information, it is possible to recover the base band signal from any one of the side band. Thus, only one side band is enough to give information without any loss any information. Such transmission system is called single side band transmission system. SSB requires transmission bandwidth that is equal to modulating signal bandwidth fm. The reduced bandwidth also improves the SNR ratio and allows more no of channels in a given bandwidth.

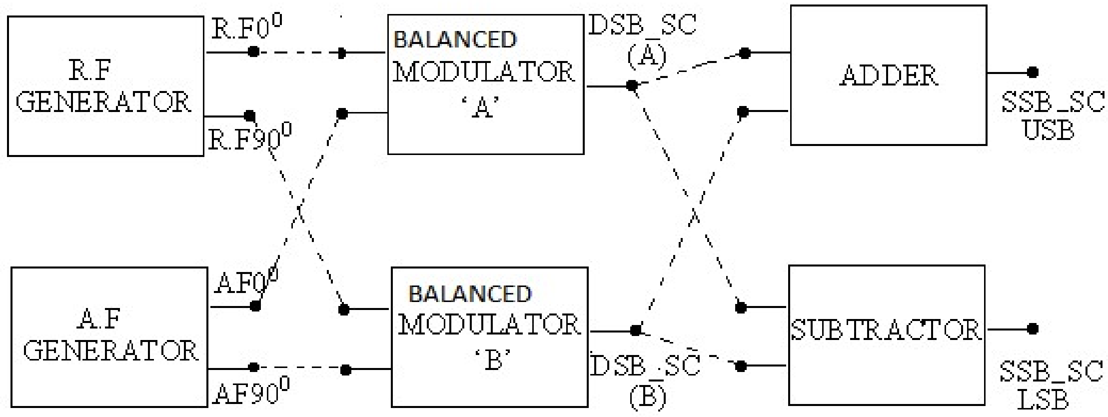
There are three well known methods of SSB generation using analog techniques, namely the filter method, the phasing method, and Weaver's method. In the phase shift method of SSBSC generation two balanced modulators and two-phase shift networks are used as shown in fig1. Both modulators produce an output consisting of sidebands. It will be shown that both upper sidebands lead the reference voltage by 90^0, and the other lags it by 90^0. The two lower side bands are thus out of phase and when combined in the adder, they cancel each other. The upper side bands are in phase at the adder and therefore they add together and gives SSB upper side band signal. When they combined in the subtractor, the upper side bands are canceling because in phase and lower side bands add together and gives SSB lower side band signal.

Demodulation :

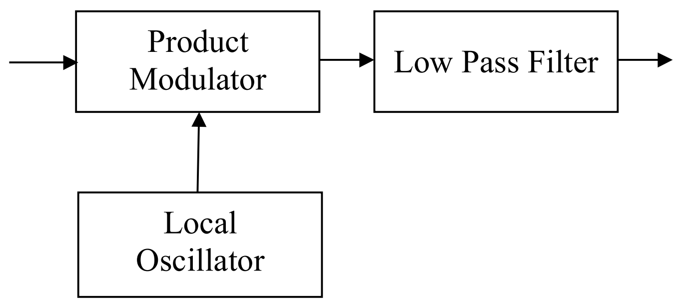
The demodulation of DSBSC signal is done by using Coherent or synchronous detection .That involves multiplying the DSB-SC signal with the carrier signal (with the same phase as in the modulation process) in a device called as product modulator. This resultant signal is then passed through a low pass filter to produce a scaled version of the original message signal.

4. BLOCK DIAGRAM:

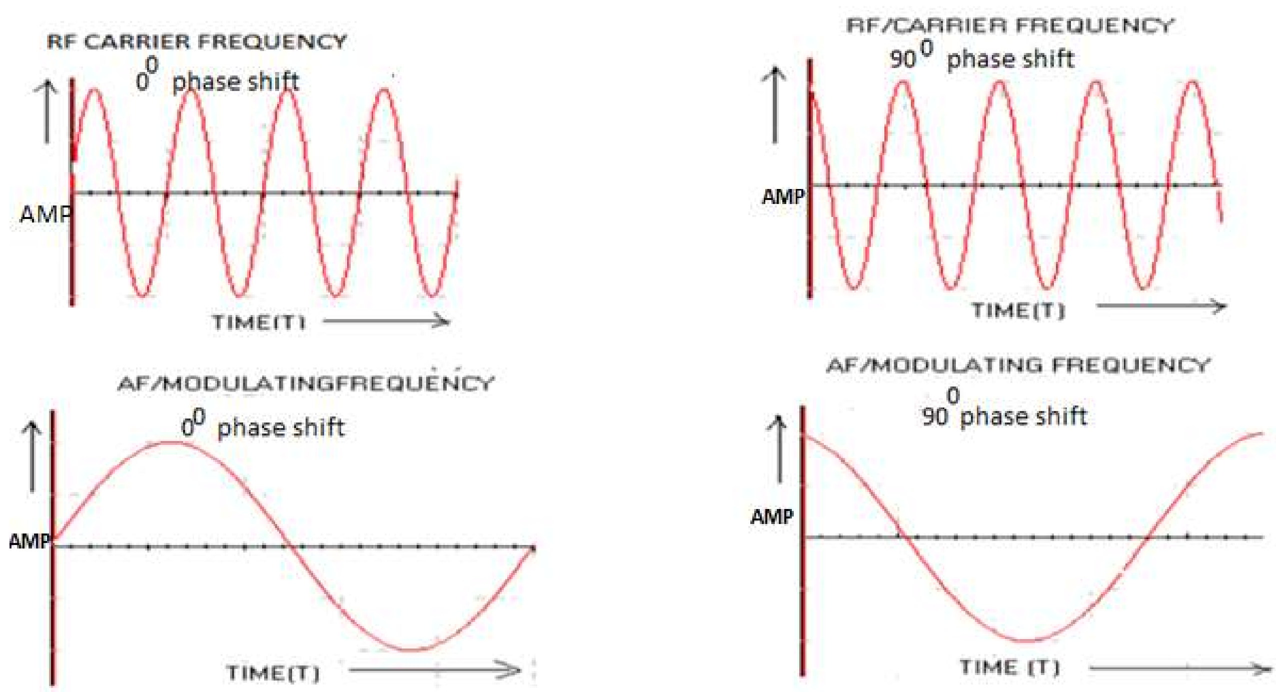
SSB MODULATION

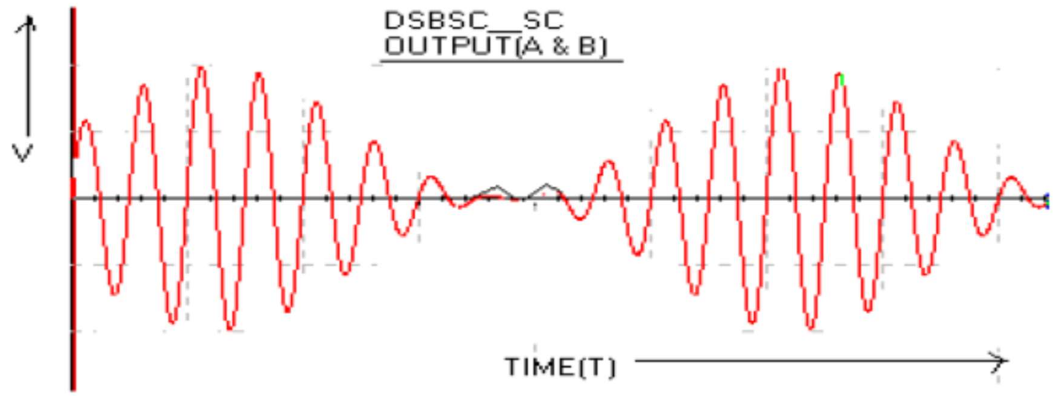


Demodulation of SSB signal Using Coherent detection:

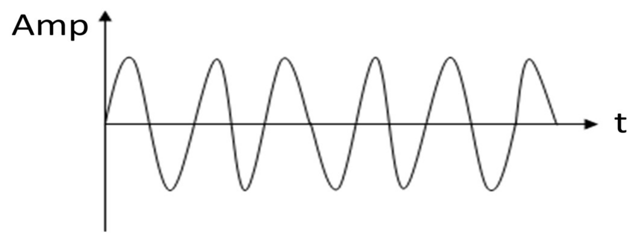


5. MODEL WAVEFORMS:

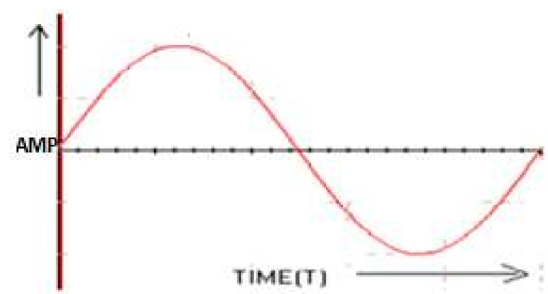




SSB Signal



Demodulated Signal



6. EXPERIMENTAL PROCEDURE:

1. Switch on the power supply through mains card.
2. Observe the output of the RF generator using CRO. Among the available two outputs of RF generator, one is with 0^0 phase shift and the other with 90° phase shift.
3. Similarly there are two o/p's available for AF generator, one is with 0^0 phase shift and the other with 90° phase shift.
4. Apply RF generator output with 0^0 phase shift and AF generator o/p with 90° phase shift to balanced modulator A and remaining two o/p's are connected to balanced modulator B.
5. Observe the both balanced modulator outputs simultaneously on the CRO and adjust the balance control until the DSBSC wave is observed on CRO. To get the SSB (LSB) signal connect balance modulator outputs to adder and note down the frequency of SSB wave

and compare this with theoretical value.

SSB (LSB) = RF frequency - AF Frequency

6. Connect the SSB signal from summer or subtractor to SSB signal input of synchronous detector and RF signal to the RF input of the synchronous detector.
7. Observe the detector output, which is replica of modulating signal (AF signal).

7. PRECAUTIONS:

1. Check for loose contacts of wires and components.
2 Keep all the control knobs in the minimum position.
3. Before switch on the power supply get the circuit connections verified by the teacher.
4. Adjust the control knobs smoothly.
5. After taking the readings bring back all the control knobs to minimum position.
6. Switch off the power supply before leaving the experimental table.

8. OBSERVATIONS:

1. Amplitude of AF 0^0 phase signal = ………………… V.
2. Frequency of AF 0^0 phase signal = ………………… Hz.
3. Amplitude of AF 90° phase signal = ………………… V.
4. Frequency of AF 90^0 phase signal = ………………… Hz.
5. Amplitude of RF 0^0 phase signal = ………………… V.
6. Frequency of RF 0^0 phase signal = ………………… Hz.
7. Amplitude of RF 90° phase signal = ………………… V.
8. Frequency of RF 90° phase signal = ………………… Hz.
9. Amplitude of SSB signal = …………………V.
10. Frequency of SSB signal = ………………… Hz.
11. Amplitude of Demodulated Signal
12. Frequency of Demodulated Signal:

9. RESULT:

The SSB modulation and de-modulation is performed.

10. VIVA -VOCE QUESTIONS:

1) What is the use of SSB modulation over DSB-SC modulation?
2) What is the amount of power saving in SSB over DSB-SC?
3) What is the bandwidth of SSB?
4) What is the application of SSB?
5) What are the advantages of SSB over conventional AM and DSB-SC?

Estimate the cutoff frequencies for Pre emphasis and De-emphasis circuits	EXPT. NO : 5
	DATE :

1. AIM:

To Estimate the cutoff frequencies for Pre emphasis and De-emphasis circuits.

2.COMPONENTS & TOOLS REQUIRED:

1. Resistors … 7.5kΩ,1kΩ
2. Capacitors .. 0.001µf
3. Cathode Ray Oscilloscope.
4. Function Generators
5. Connecting wires

3. THEORY:

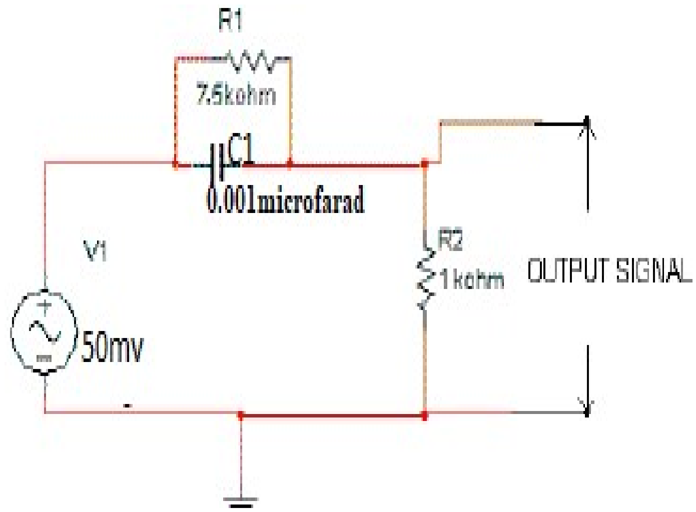
Pre-emphasis: Pre-emphasis refers to boosting the relative amplitudes of the modulating voltage for higher frequencies. Signals with higher modulation frequencies have lower SNR. In order to compensate this, the high frequency signals are emphasized or boosted in amplitude at the transmitter section of a communication system prior to the modulation process. That is, the pre- emphasis network allows the high frequency modulating signal to modulate the carrier at higher level. It acts as a high pass filter. The cut off frequency is determined by the RC time constant of the network. By the use of an active pre-emphasis network, we can reduce the signal loss and distortion with the increase of SNR. Also, the output amplitude of the network increases with frequencies above cut off frequency.

De-Emphasis: De-emphasis circuit is used to attenuate the high frequency signal that is boosted at the transmitter section. The circuit is placed at the receiving side. It acts as a low pass filter. The cut off frequency is given by the formula $f_c = 1/(2\pi RC)$

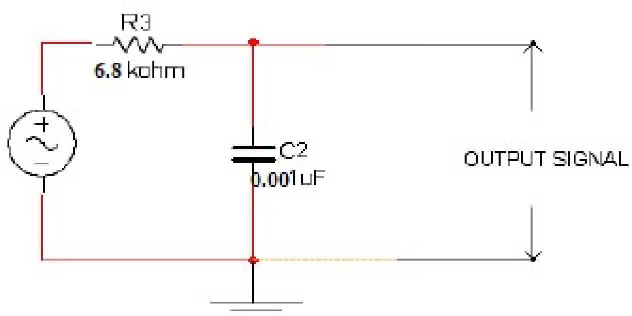
The pre- emphasis network in front of the FM modulator and a de-emphasis network at the output of the FM demodulator improves the Signal to Noise Ratio for higher modulating signal frequencies, thus producing a more uniform SNR at the output of demodulator

4. CIRCUIT DIAGRAM:

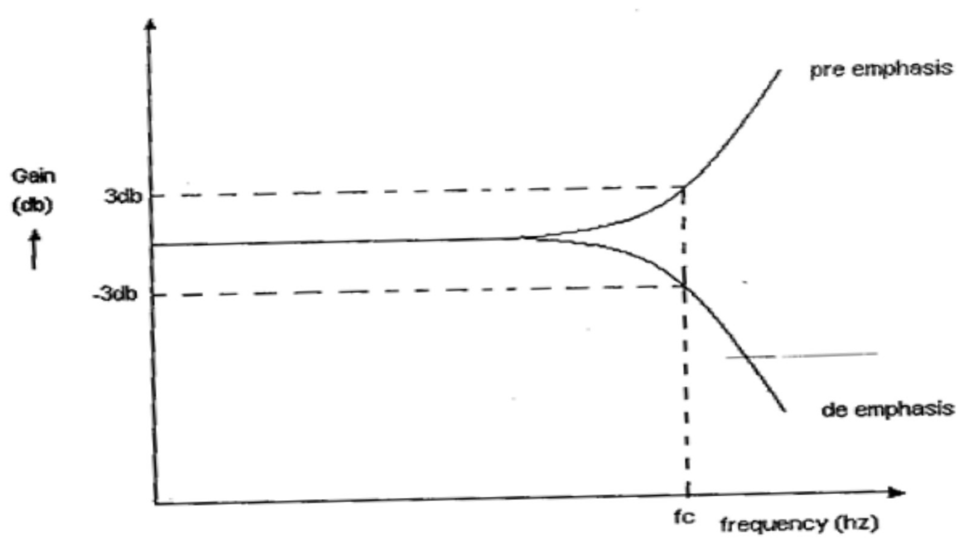
Pre-emphasis Circuit:



Deemphasis Circuit:



5. MODEL WAVEFORMS:



6. EXPERIMENTAL PROCEDURE:

1. Connect the pre-emphasis circuit as shown in figure.
2. Switch on the power supply through mains card.

3. Set the output of AF generator using CRO to 50mvpp and frequency range 200HZ to 30KHZ
4. Apply the AF signal to pre-emphasis network
5. Connect CRO to the output of pre-emphasis network and observe the waveform.
6. By varying AF signal frequency (input amplitude must be kept constant) in steps, note output voltage in tabular form.
7. Plot the graph by taking the frequency on X – axis and gain in dB on Y- axis .
8. From the graph note the frequency at which the output is 70.7% of input voltage and compare with the theoretical value which is given by 1/2πRC.
9. Connect the De-emphasis circuit as shown in figure
10. Set the output of AF generator using CRO to 2v pp and frequency range 1KHz to 30KHZ
11 . Apply AF signal to De-emphasis network.
12. By varying AF signal frequency (input amplitude must be kept constant) in steps. Note down the corresponding input and output voltages in tabular forms.
13. Plot the graph by taking the frequency on X – axis and gain in dB on Y- axis.
14. From the graph note the frequency at which the output is 70.7% of input voltage and compare with the theoretical value which is given by 1/2πRC.

7. PRECAUTIONS:

1. Check for loose contacts of wires and components.
2. Keep all the control knobs in the minimum position.
3. Before switch on the power supply get the circuit connections verified by the teacher. Adjust the control knobs smoothly.
4. After taking the readings bring back all the control knobs to minimum position.
5. Switch off the power supply before leaving the experimental table.

8. OBSERVATIONS:

Pre emphasis :

Input voltage V_i =

Frequency(Hz)	Output Voltage(Volts)	Gain(dB)

De-emphasis :

Input voltage V_i =

Frequency(Hz)	Output Voltage(Volts)	Gain(dB)

9. RESULT:

The frequency response of pre-emphasis and de-emphasis was obtained

10. VIVA -VOCE QUESTIONS:

1. What is pre-emphasis?
2. What is de-emphasis?
3. What is the necessity of pre-emphasis and de-emphasis circuits?
4. Where we use the pre-emphasis and de-emphasis circuits?
5. Can we use the pre-emphasis and de-emphasis circuits in AM receivers?

Generate the Pulse Amplitude Modulated signal and reconstruct the original signal using low pass filter	EXPT. NO: 6
	DATE :

1. AIM:

To generate the Pulse Amplitude Modulated signal and reconstruct the original signal using low pass filter.

2. COMPONENTS & TOOLS REQUIRED:

1. PAM Trainer kit
2. 30 kHz dual channel oscilloscope
3. CRO probes and patch chords.

3. THEORY:

Pulse Amplitude Modulation (PAM) is an analog modulation scheme in which the amplitude of the pulse carrier varies proportional to the instantaneous amplitude of the message signal.

Based on the shape of the generated pulses, two types of PAM techniques exist.

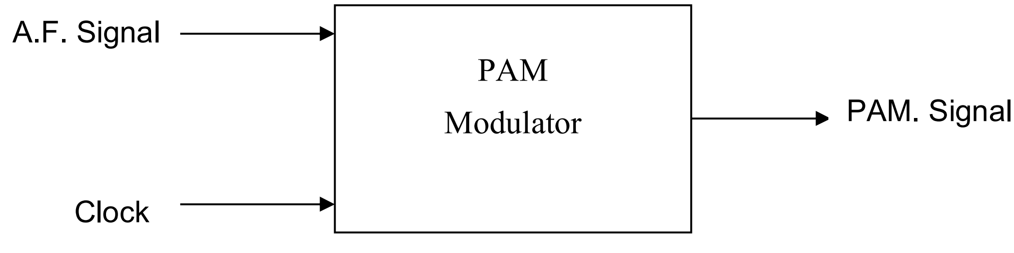
- Natural PAM
- Flat top PAM

In natural PAM, the amplitude of modulated signal is proportional to the modulating signal amplitude during pulse occurrence.

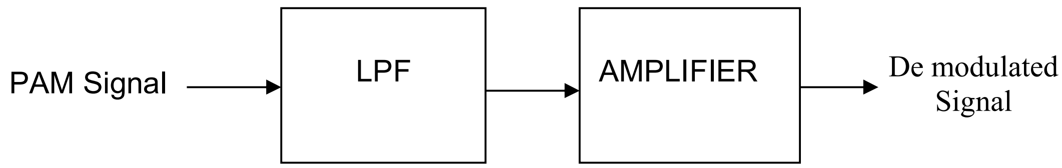
In flat-top PAM, the amplitude of the modulated pulses remains flat and is equal to the instantaneous value of the base band signal at the start of the sample.

4. BLOCK DIAGRAM:

MODULATOR



DEMODULATOR



5. MODEL WAVEFORMS:

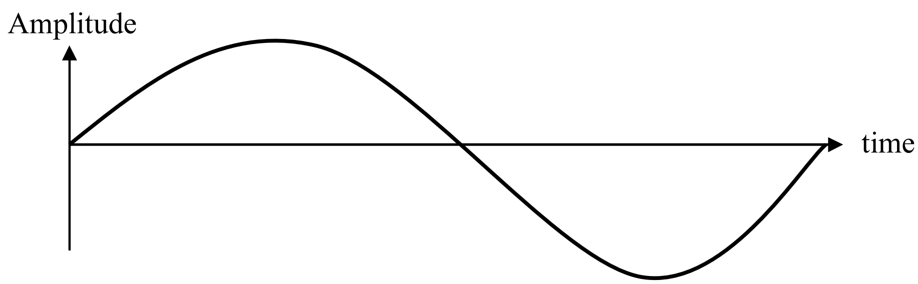


Fig: Message Signal or Modulating Signal

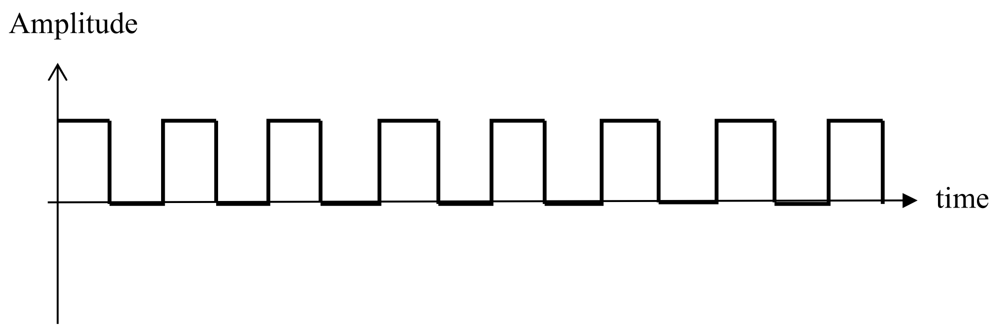


Fig: Carrier Pulse Train

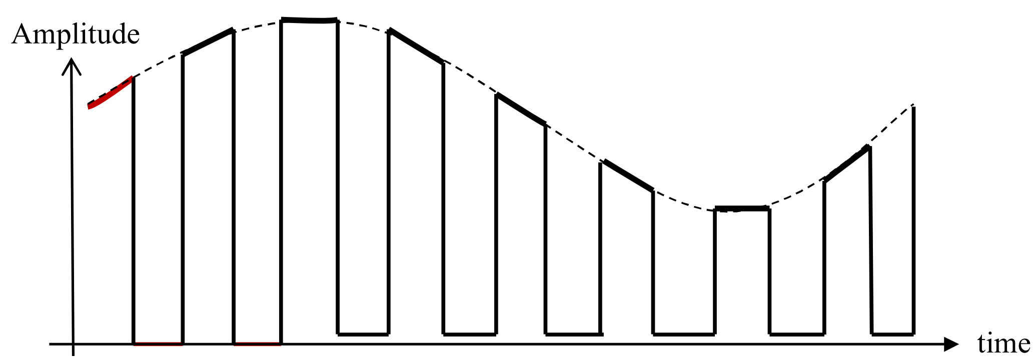


Fig: Pulse Amplitude Modulated(PAM) Signal

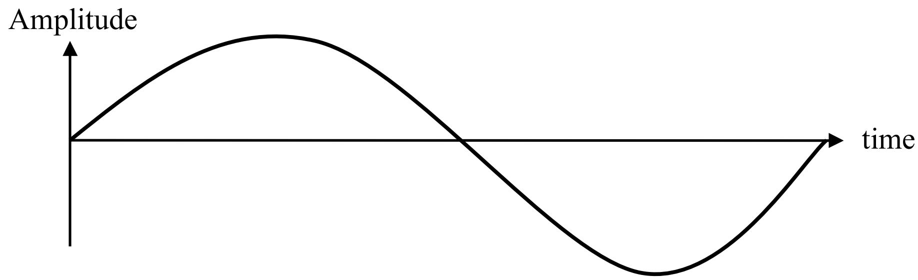


Fig: De-Modulated Signal

6. EXPERIMENTAL PROCEDURE:

1. Switch on the trainer kit.
2. Observe the modulating signal and carrier clock generator outputs
3. Adjust the modulating signal generator output to convenient value
4. Apply the modulating signal generator output and clock generators output to the PAM modulator.
5. Observe the PAM output waveforms by varying the amplitudes of the modulating signal and modulation depths.
6. During demodulation connect PAM output to the input of the PAM demodulator and observe the output of PAM demodulator.

7. PRECAUTIONS:

1. Check for loose contacts of wires and components.
2. Keep all the control knobs in the minimum position.
3. Before switch on the power supply get the circuit connections verified by the teacher.
4. Adjust the control knobs smoothly.
5. After taking the readings bring back all the control knobs to minimum position.
6. Switch off the power supply before leaving the experimental table.

8. OBSERVATIONS:

1. Amplitude of the modulating signal______________
2. Frequency of the modulating signal________________
3. Amplitude of the De-modulated signal_____________
4. Frequency of the De-modulated signal______________

9. RESULT:

The Pulse Amplitude Modulated signal is generated and original signal is reconstructed using low pass filter.

10. VIVA -VOCE QUESTIONS:

1. What is sampling?
2. What is sampling theorem?
3. What are the various types of Pulse modulation techniques?
4. Define PAM?
5. Mention any two applications of PAM.
6. What is the purpose of sample and hold circuit in PAM?

Construct circuits for generating the Pulse width modulated signal using IC555 and perform demodulation to reconstruct the message signal	EXPT. NO : 7(A)
	DATE :

1.AIM:

To perform pulse width modulation and demodulation.

2. COMPONENTS & TOOLS REQUIRED:

1. PWM Trainer kit
2. 30 kHz dual channel oscilloscope
3. CRO probes and patch chords.

3. THEORY:

Pulse Width Modulation (PWM) or Pulse Duration Modulation (PDM) or Pulse Time Modulation (PTM) is an analog modulating scheme in which the duration or width or time of the pulse carrier varies proportional to the instantaneous amplitude of the message signal.

The width of the pulse varies in this method, but the amplitude of the signal remains constant. Amplitude limiters are used to make the amplitude of the signal constant. These circuits clip off the amplitude, to a desired level and hence the noise is limited.

There are three variations of PWM. They are

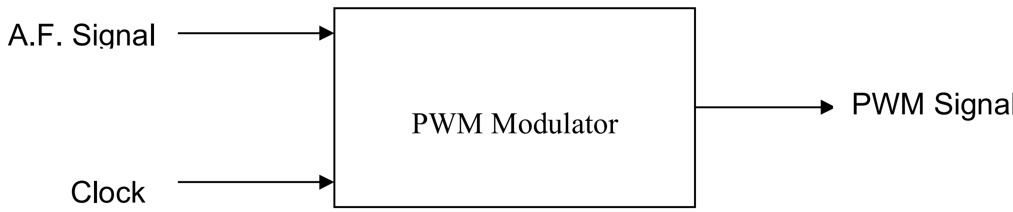
The leading edge of the pulse being constant, the trailing edge varies according to the message signal.

The trailing edge of the pulse being constant, the leading edge varies according to the message signal.

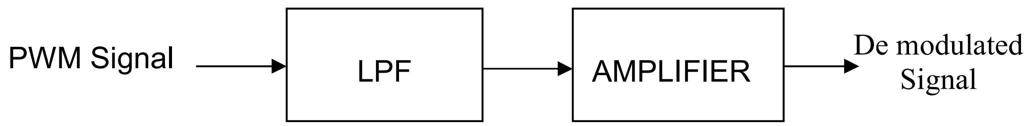
The center of the pulse being constant, the leading edge and the trailing edge varies according to the message signal.

4.BLOCK DIAGRAM:

MODULATOR



DEMODULATOR



5.MODEL WAVEFORMS :

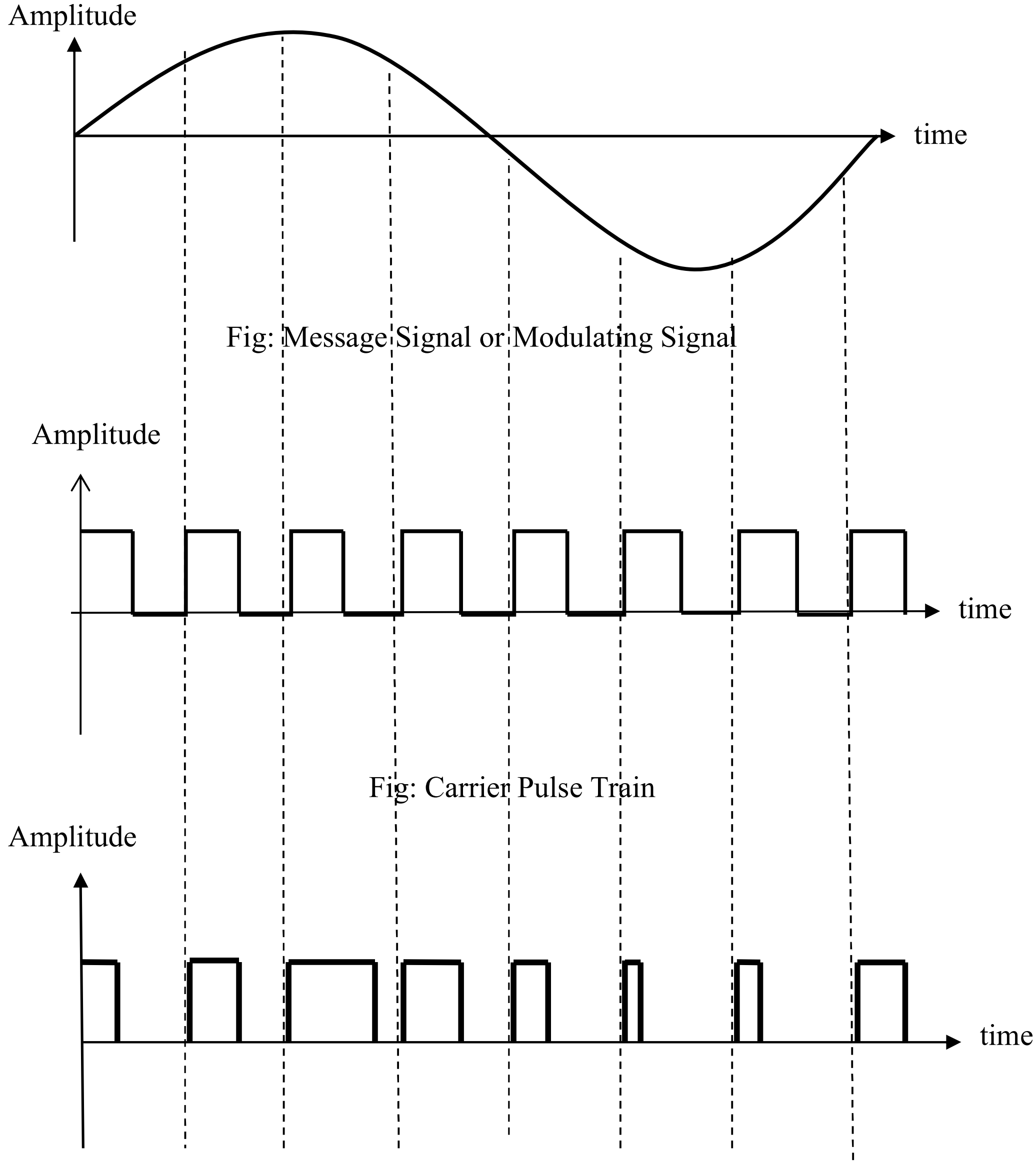


Fig: Message Signal or Modulating Signal

Fig: Carrier Pulse Train

Fig: Pulse Width Modulated(PWM) Signal

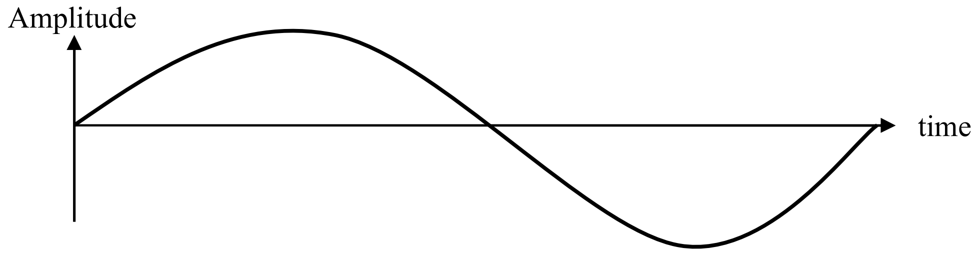


Fig: De-modulated Signal

6. EXPERIMENTAL PROCEDURE:

1. Switch on the trainer kit.
2. AF signal is connected to the PWM modulator from AF generator block using a Patch chord. Observe width of the pulses in PWM output by varying amplitude of AF signal (Modulating signal)
3. PWM is applied as an input to PWM demodulator circuit which includes higher order low pass filter and AC amplifier.
4. Observe the output of AC amplifier (at PWM de-modulator) which is a true replica of modulating signal (AF signal).

7. PRECAUTIONS:

1. Check for loose contacts of wires and components.
2. Keep all the control knobs in the minimum position.
3. Before switch on the power supply get the circuit connections verified by the teacher.
4. Adjust the control knobs smoothly.
5. After taking the readings bring back all the control knobs to minimum position.
6. Switch off the power supply before leaving the experimental table.

8. OBSERVATIONS:

1. Amplitude of the modulating signal_______________
2. Frequency of the modulating signal_________________
3. Amplitude of the De-modulated signal______________
4. Frequency of the De-modulated signal_______________

9. RESULT:

The pulse width modulation and demodulation are performed.

10. VIVA -VOCE QUESTIONS:

1. What is the other name of pulse width modulation?
2. What is duty cycle?
3. Define PWM?
4. What are different types of PWM?
5. Mention any two applications of PWM.

Construct circuits for generating the Pulse position modulated signals using IC555 and perform demodulation to reconstruct the message signal	EXPT. NO : 7(B)
	DATE :

1. AIM:

To perform pulse position modulation and demodulation

2. COMPONENTS & TOOLS REQUIRED:

1. PPM Trainer kit
2. 30 kHz dual channel oscilloscope
3. CRO probes
4. Patch cords.

3. THEORY:

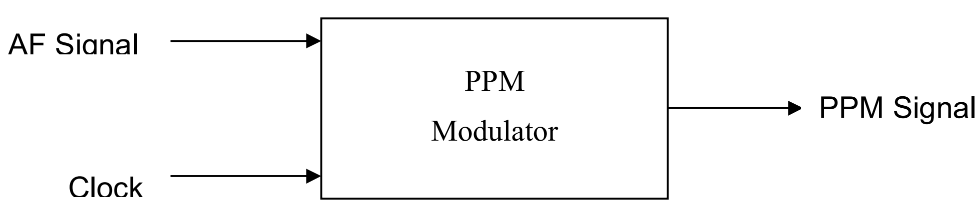
Pulse Position Modulation (PPM) is an analog modulating scheme in which the amplitude and width of the pulses are kept constant, while the position of each pulse, with reference to the position of a reference pulse varies according to the instantaneous sampled value of the message signal.

Pulse position modulation is done in accordance with the pulse width modulated signal. Each trailing of the pulse width modulated signal becomes the starting point for pulses in PPM signal. Hence, the position of these pulses is proportional to the width of the PWM pulses.

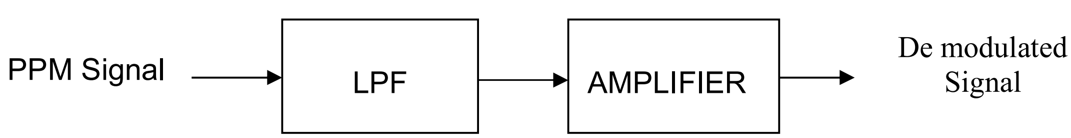
The advantage of PPM is that it requires constant transmitter power but the disadvantage is depending on transmitter and the receiver synchronization.

4. BLOCK DIAGRAM:

MODULATOR



DEMODULATOR



5.MODEL WAVEFORMS:

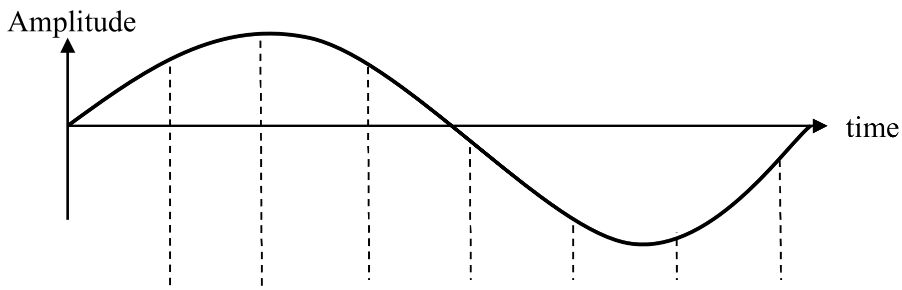


Fig.1: Message Signal or Modulating Signal

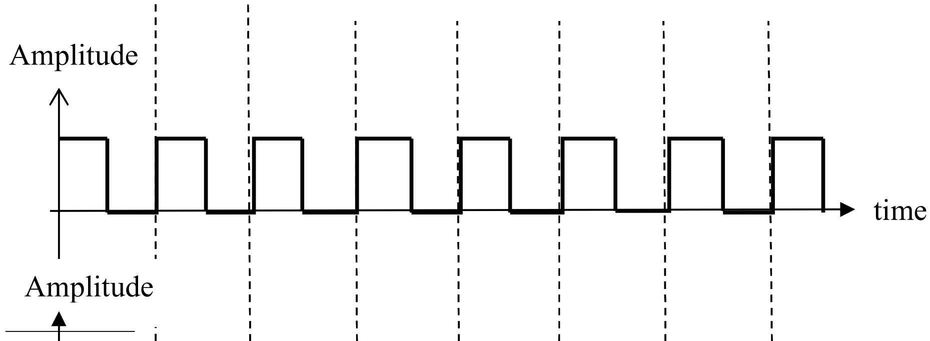


Fig.2: Carrier Pulse Train

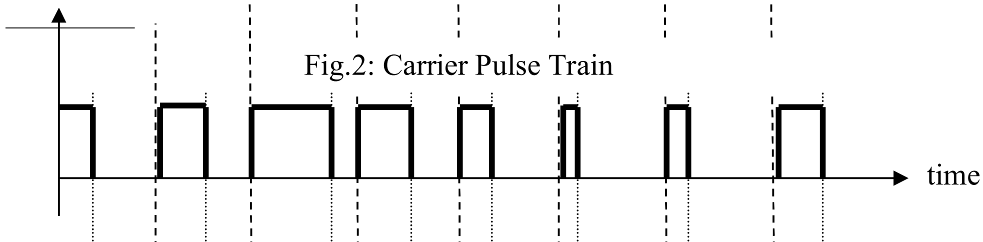


Fig.3: Pulse Width Modulated(PWM) Signal

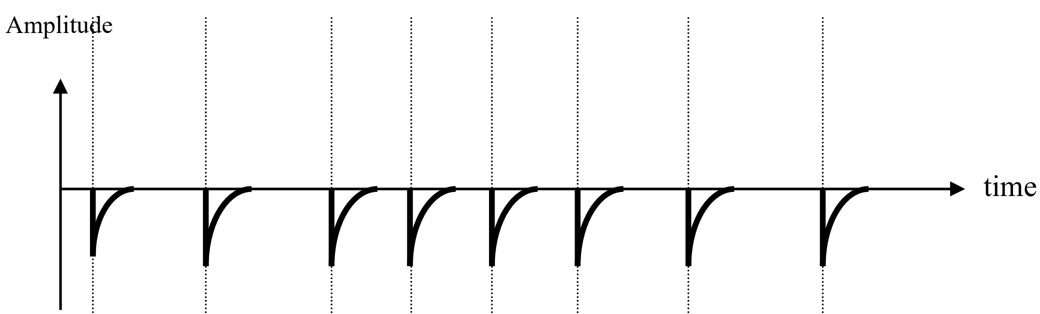


Fig.4: Output of differentiator

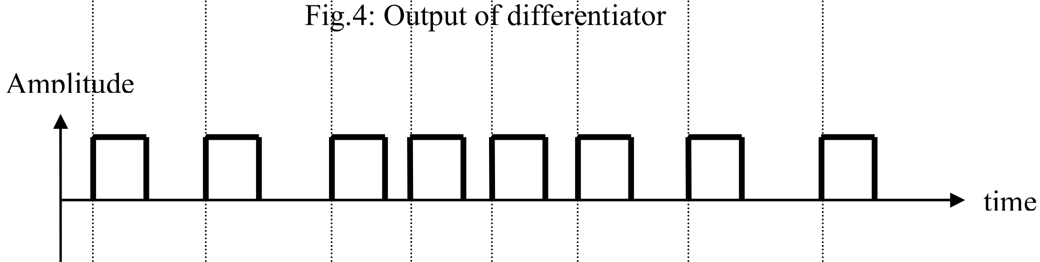


Fig.5: Pulse Position Modulated (PPM) Signal

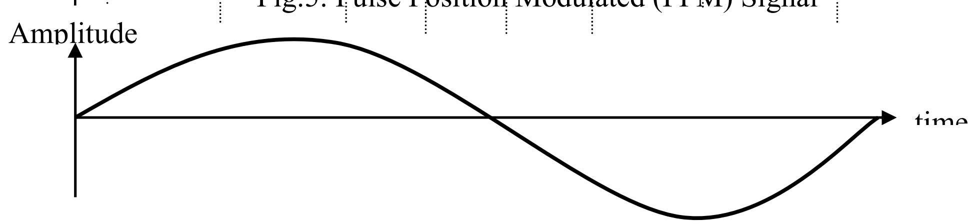


Fig.6: De-modulated Signal

6. EXPERIMENTAL PROCEDURE:

1. Switch on the trainer kit.
2. A fixed frequency sinusoidal signal is connected to the PPM modulator from AF generator block using a Patch chord and set the amplitude pot in AF generator to convenient value.
3. Now monitor the output of the PPM modulator.
4. Observe position of the pulses in PPM output by varying amplitude of AF signal (Modulating signal).
5. For De-modulation PPM is applied as an input to PWM demodulator circuit which includes higher order low pass filter and AC amplifier.
6. As the output of LPF is having less amplitude, connect the output of LPF to input of AC Amplifier.
7. Observe the output of AC amplifier (at PWM de-modulator) which is a true replica of modulating signal (AF signal).

7.PRECAUTIONS:

1. Check for loose contacts of wires and components.
2. Keep all the control knobs in the minimum position.
3. Before switch on the power supply get the circuit connections verified by the teacher.
4. Adjust the control knobs smoothly.
5. After taking the readings bring back all the control knobs to minimum position.
6. Switch off the power supply before leaving the experimental table.

8. OBSERVATIONS:

1. Amplitude of the modulating signal______________
2. Frequency of the modulating signal________________
3. Amplitude of the De-modulated signal_____________
4. Frequency of the De-modulated signal______________

9. RESULT:

The pulse position modulation and demodulation are performed.

10. VIVA -VOCE QUESTIONS:

1. Define PPM?
2. Mention the advantages of PPM.
3. Explain how PPM wave is generated from PWM wave.
4. Why synchronization is required to demodulate PPM wave?
5. Mention any two applications of PPM.
6. hat are the applications of PPM?

Generation of sampled signal for different sampling rates and verify sampling theorem for efficient reconstruction	EXPT. NO : 8
	DATE :

1. AIM :

To observe sampled signals for different sampling rates and verify sampling theorem.

2. COMPONENTS & TOOLS REQUIRED :

1. Sampling theorem Trainer kit
2. 30 kHz dual channel oscilloscope
3. CRO probes
4. Patch chords.

3. THEORY:

Sampling is the processes of converting continuous time analog signal into discrete time signal by taking the “samples” at discrete-time intervals. Sampling theorem states that, a continuous time signal can be represented in its samples and can be recovered back when sampling frequency f_s is greater than or equal to the twice the highest frequency component of message signal. i. e.

$$fs \geq 2w.$$

There are three types of sampling techniques:

- Instantaneous or sampling.
- Natural sampling.
- Flat Top sampling.

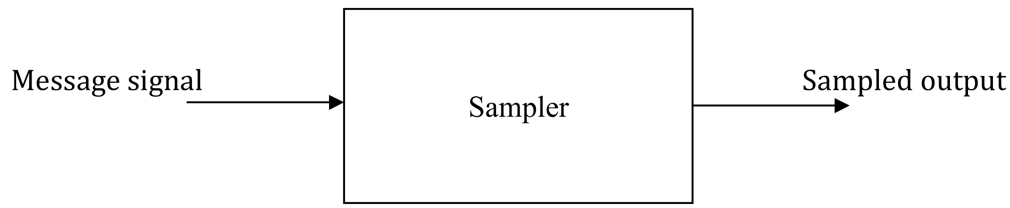
Out of these three, instantaneous sampling is called ideal sampling which uses the train of impulses as a carrier. The instantaneous sampling results in the samples whose width τ approaches zero. Due to this, the power content in the instantaneously sampled pulse is negligible. Thus, this method is not suitable for transmission purpose. Thus, natural sampling and flat-top sampling are called practical sampling methods.

In natural sampling, the sampled signal is a pulse of short width with varying amplitude with natural tops i.e. the amplitude of carrier pulse train is proportional to the modulating signal amplitude during pulse occurrence. In flat-top sampling, the top of the samples are flat i.e. they have constant amplitude. Hence, it is called as flat top sampling or practical sampling. Flat top sampling makes use of sample and hold circuit. The minimum time interval required to recover the message signal from sampled signal is called Nyquist interval and the respective frequency is called Nyquist frequency.

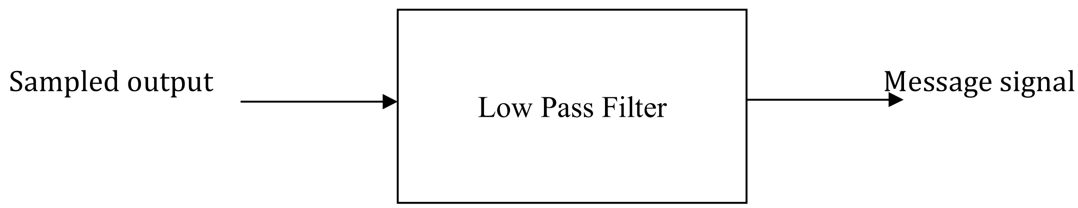
$$T_s = 1/2w \quad \text{and} \quad f_s = 2\,w$$

4.BLOCK DIAGRAM

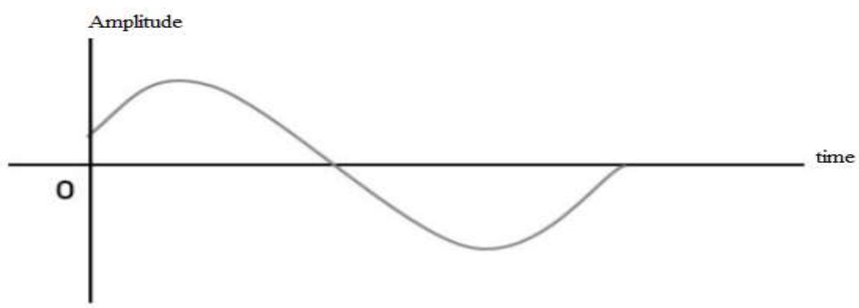
Sampling:



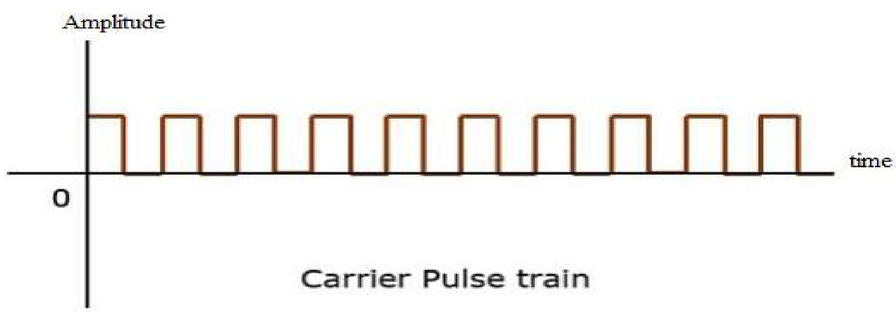
Reconstruction:



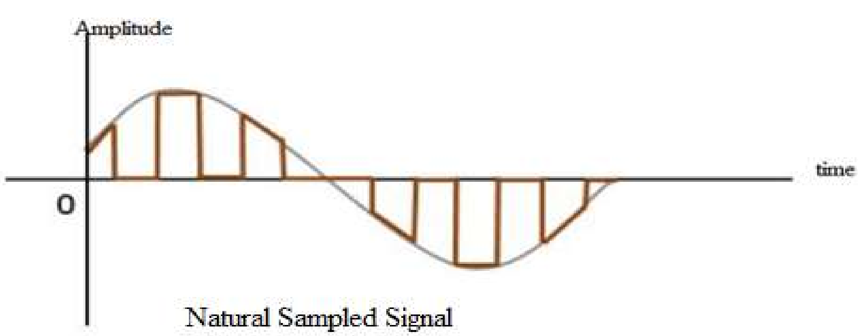
5. MODEL WAVEFORMS:



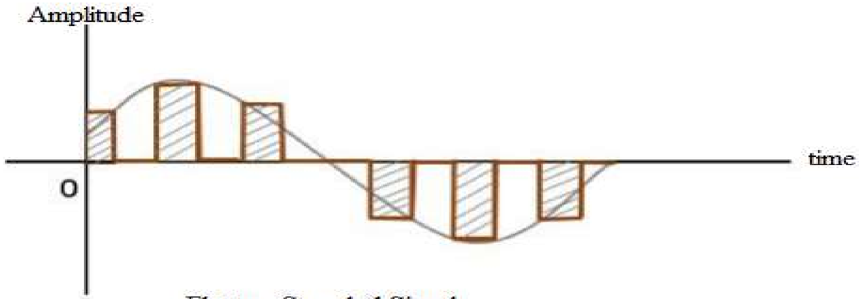
Modulating signal



Carrier Pulse train



Natural Sampled Signal



Flat top Sampled Signal

6. EXPERIMENTAL PROCEDURE:

1. Ensure that the EXT/INT sampling selector switch is in INT position.
2. Put the DUTY CYCLE selector switch in position 5.
3. Link 1 kHz sine wave output to analog input.
4. Turn on the trainer.
5. Turn on the trainer select 32 kHz sampling rate by default.
6. Display 1kHz sine wave (TP12) and sampled output (TP37) on a CRO the display shows 1kHz sine wave being at 32 kHz, so there are 32 samples for every cycle of sine wave.
7. Link the sample output to fourth order low pass filter, Display sample output and output of filter (TP46) on the CRO. The display shows the reconstructed original 1kHz sine wave.
8. By successive process of frequency selector switch change the sampling frequency to 2,4,8,16,32 kHz. Observe how sample output changes in each case and how the low order sampling frequencies introduce distortions in to filter output.

7.PRECAUTIONS:

1. Check for loose contacts of wires and components.
2. Keep all the control knobs in the minimum position.
3. Before switch on the power supply get the circuit connections verified by the teacher.
4. Adjust the control knobs smoothly.
5. After taking the readings bring back all the control knobs to minimum position.
6. Switch off the power supply before leaving the experimental table.

8. OBSERVATION:

1. Amplitude of the modulation Signal:
2. Frequency of the Modulating signal:
3. Amplitude of the Reconstructed Signal:
4. Frequency of the Reconstructed Signal:

9. RESULT:

Sampled signals for different sampling rates are observed and Sampling theorem is verified

10. VIVA -VOCE QUESTIONS:

1. What is sampling and mention the types of sampling?
2. Sate the sampling theorem?
3. Explain about natural and flat top sampling.
4. Define Nyquist Interval.
5. Explain the need of sampled and hold circuit for sampling purpose.

PART –B
(Simulation Using MATLAB)

Amplitude Modulation & Demodulation	EXPT. NO :9
	DATE :

1.AIM:

To simulate Amplitude modulation and demodulation using MATLAB.

2.EQUIPMENT REQUIRED:

1. Personal Computer.
2. MAT Lab Version 9.1

3.THEORY:

Amplitude Modulation may be defined as a system in which the maximum amplitude of the carrier wave is made proportional to the instantaneous value (amplitude) of the modulating or baseband signal.

Consider a sinusoidal carrier wave c(t) given as $c(t) = A\cos(\omega_c t)$.

Here, A is the maximum amplitude of the carrier wave and ω_c is the carrier frequency.

Let x(t) denotes the modulating or base band signal then according to the amplitude modulation, the maximum amplitude A of the carrier will have to be made proportional to the instantaneous amplitude of the modulating signal x(t).

In the process of amplitude modulation, the frequency and phase of the carrier remain constant whereas the maximum amplitude varies according to the instantaneous value of the information signal.

4.PROCEDURE:-

1. Open the MATLAB software by double clicking the icon on desktop.
2. Open the new M-file by using file menu.
3. Write the program in new file.
4. Click on save the file with .m extension and execute run the icon.
5. Perform error check which displayed on command window.
6. Plot the waveforms displayed on figure window.
7. Note down the values, which are displayed on the command window.

5.PROGRAM:

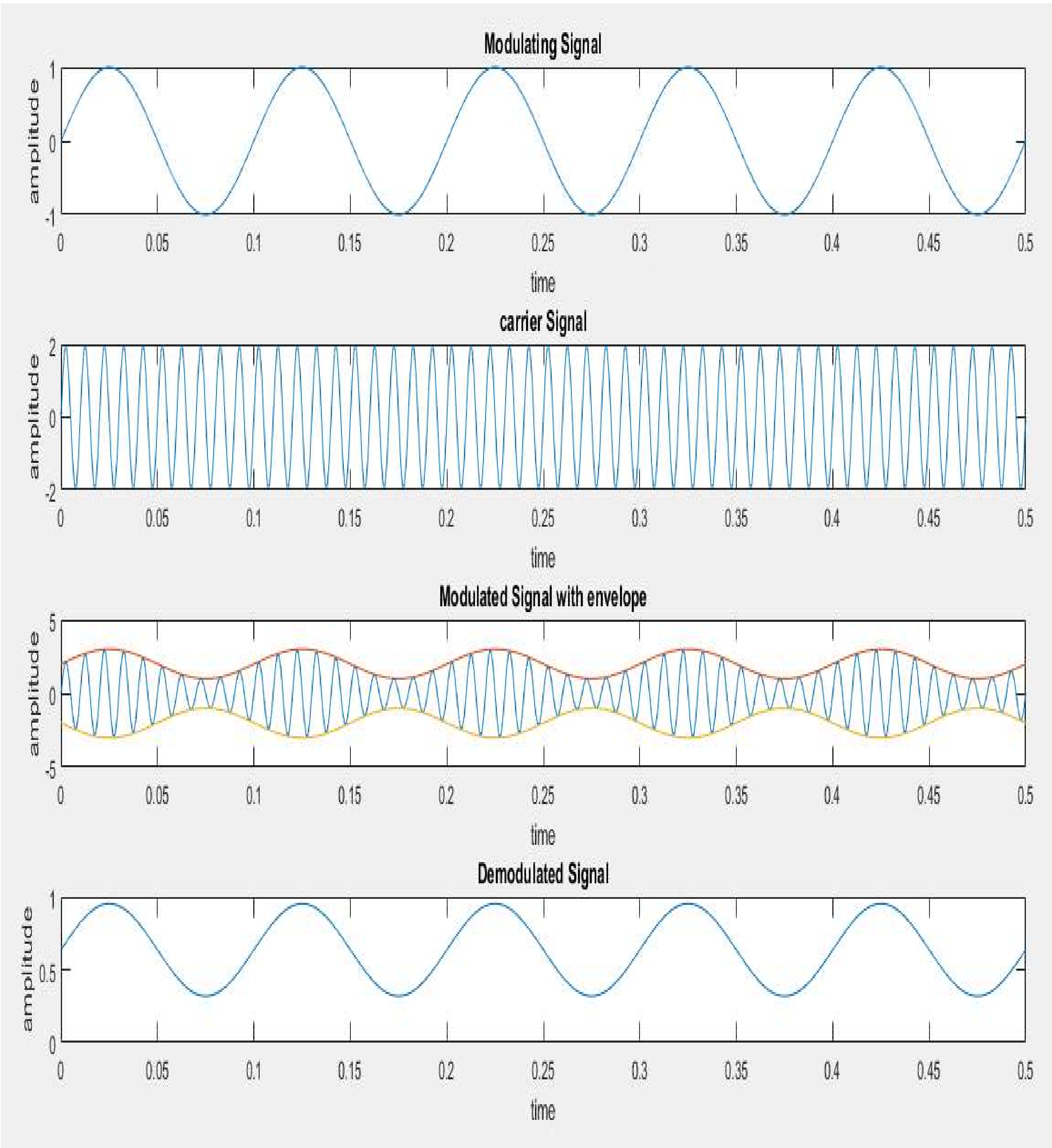
```
clc
clear all
close all
%This program simulates the generation and demodulation an
amplitude modulated signal.
t = 0:.001:.5;
am =1;
ac =2;
fm =10;
fc =100;
wc1 = 2*pi*fm;
wc2 = 2*pi*fc;
k = am/ac;
ct = ac*sin(wc2*t);
mt = am*sin(wc1*t);
s = (1+k*mt).*ct;
subplot (4,1,1)
plot (t, mt)
xlabel('time')
ylabel('amplitude')
title ('Modulating Signal')
subplot (4,1,2)
plot (t, ct)
xlabel('time')
ylabel('amplitude')
title ('carrier Signal')
subplot (4,1,3)
plot (t, s, t, ac+mt, t, -ac-mt)
title ('Modulated Signal with envelope')
xlabel('time')
ylabel('amplitude')
subplot (4,1,4)
s2 = (1/pi)*(ac+mt);
plot (t, s2)
title ('Demodulated Signal')
xlabel('time')
ylabel('amplitude')
```

6.PRECAUTIONS:

1. Check out source file is with '.m' extension or not.
2. The file name should begin with character and should not contain any punctuation marks.
3. File name should not be any in built in function name or any keyword
4. Save the .m files preferably in work folder of MATLAB.

5. Don’t delete any file or folder without informing the system administrator or lab in-charge.

7.MODEL WAVE FORMS:



8.RESULT:

Amplitude Modulation and demodulation is simulated using MATLAB.

Frequency Modulation & Demodulation	EXPT. NO :10
	DATE :

1.AIM:

To simulate Frequency modulation and demodulation using MATLAB.

2.EQUIPMENT REQUIRED:

1. Personal Computer.
2. MAT Lab Version 9.1

3.THEORY:

Frequency Modulation is defined as the process of varying the frequency of carrier signal in accordance with the instantaneous value of message signal.

Let the baseband data signal (the message) to be transmitted is $x_m(t)$ and the sinusoidal carrier is $x_c(t) = A_c \cos(2\pi f_c t)$, where f_c is the carrier's base frequency and A_c is the carrier's amplitude. The modulator combines the carrier with the baseband data signal to get the transmitted signal:

Although it may seem that this limits the frequencies in use to $f_c \pm f_\Delta$, this neglects the distinction between *instantaneous frequency* and *spectral frequency*. The frequency spectrum of an actual FM signal has components extending out to infinite frequency, although they become negligibly small beyond a point.

4.PROCEDURE: -

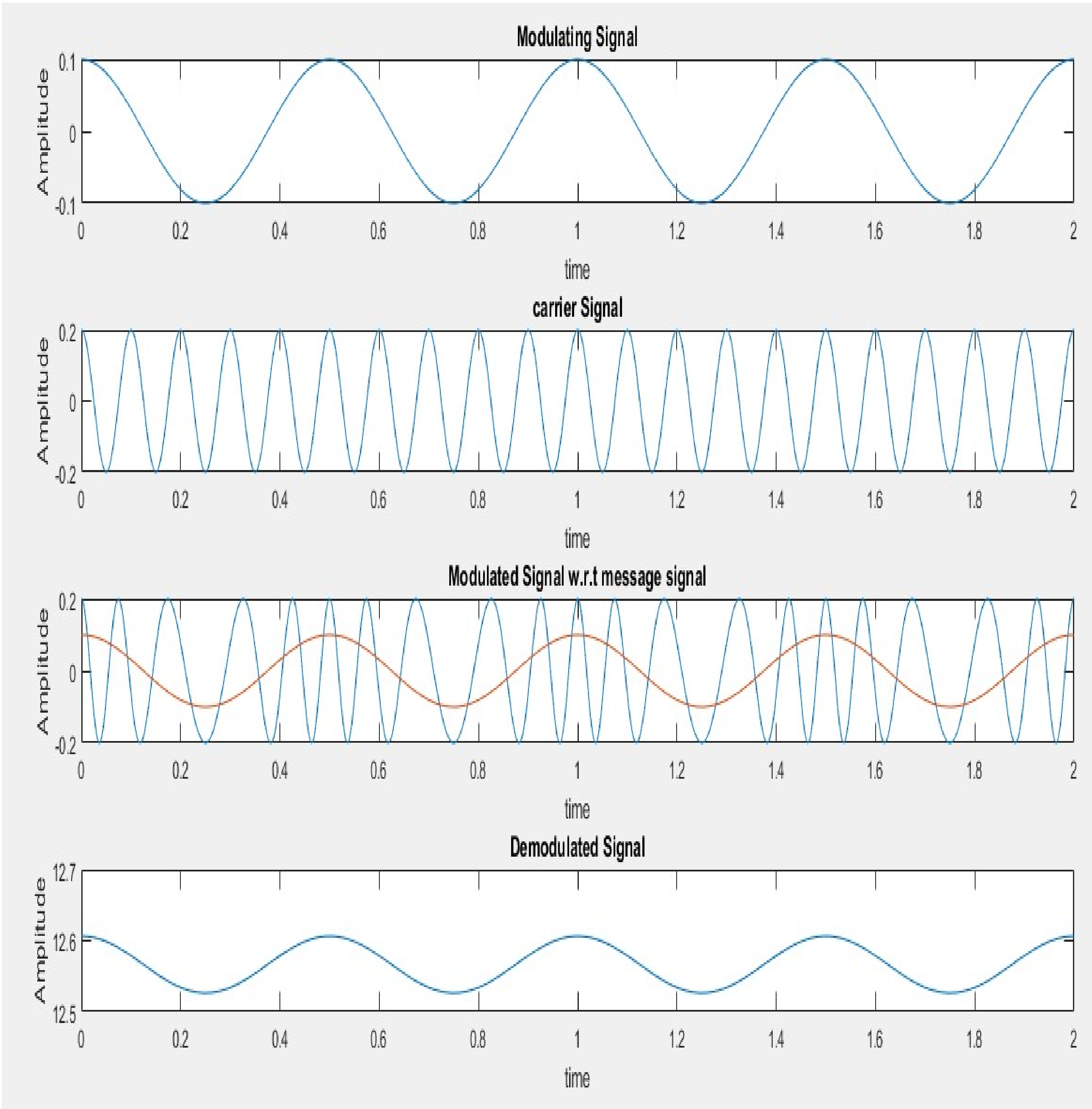
1. Open the MATLAB software by double clicking the icon on desktop.
2. Open the new M-file by using file menu.
3. Write the program in new file.
4. Click on save with .m extension and execute run the icon .
5. Perform error check which displayed on command window.
6. Plot the waveforms displayed on figure window.
7. Note down the values, which are displayed on the command window.

5.PROGRAM:

```
clc
clear all
close all
%This program simulates the simulates the generation and %demodulation of
Frequency Modulated Signal
t=0:.001:2;
```

```
am = .1;
ac = .2;
fm = 2;
fc = 10;
 k = 2;
 wc1 = 2*pi*fm;
wc2 = 2*pi*fc;
mt = am*cos (wc1*t);
ct = ac*cos (wc2*t);
 s = ac*cos (wc2*t + k*sin (wc1*t));
subplot (4,1,1)
plot (t, mt)
title ('Modulating Signal')
xlabel('time')
ylabel('Amplitude')
subplot (4,1,2)
plot (t, ct)
title ('carrier Signal')
xlabel('time')
ylabel('Amplitude')
subplot (4,1,3)
plot (t, s, t, mt)
title ('Modulated Signal w.r.t message signal')
xlabel('time')
ylabel('Amplitude')
subplot (4,1,4)
 s2 = ac*(wc2+k*mt);
plot (t, s2)
title ('Demodulated Signal')
xlabel('time')
ylabel('Amplitude')
```

6.MODEL WAVE FORMS:



7.PRECAUTIONS:

1. Check out source file is with '.m' extension or not.
2. The file name should begin with character and should not contain any punctuation marks.
3. File name should not be any in built in function name or any keyword
4. Save the .m files preferably in work folder of MATLAB.
5. Don't delete any file or folder without informing the system administrator or lab in-charge.

8.RESULT: Frequency modulation and demodulation is implemented by using MATLAB.

Pulse Amplitude Modulation & Demodulation	EXPT. NO :11
	DATE :

1.AIM:

To simulate Pulse Amplitude Modulation & Demodulation using MATLAB

2.EQUIPMENT REQUIRED:

1. Personal Computer.
2. MAT Lab Version 9.1

3.THEORY: Pulse modulation is a technique in which the signal is transmitted with the information by pulses. This is divided into Analog Pulse Modulation and Digital Pulse Modulation. Analog pulse modulation techniques are classified as

- Pulse Amplitude Modulation (PAM)
- Pulse Width Modulation (PWM)
- Pulse Position Modulation (PPM)

Pulse Amplitude Modulation

Pulse amplitude modulation is a technique in which the amplitude of each pulse is controlled by the instantaneous amplitude of the modulation signal. It is a modulation system in which the signal is sampled at regular intervals and each sample is made proportional to the amplitude of the signal at the instant of sampling. This technique transmits the data by encoding in the amplitude of a series of signal pulses.

4.PROCEDURE:-

1. Open the MATLAB software by double clicking the icon on desktop.
2. Open the new M-file by using file menu.
3. Write the program in new file.
4. Click on save with .m extension and execute the program using run icon.
5. Perform error check which displayed on command window.
6. Plot the waveforms displayed on figure window.
7. Note down the values, which are displayed on the command window.

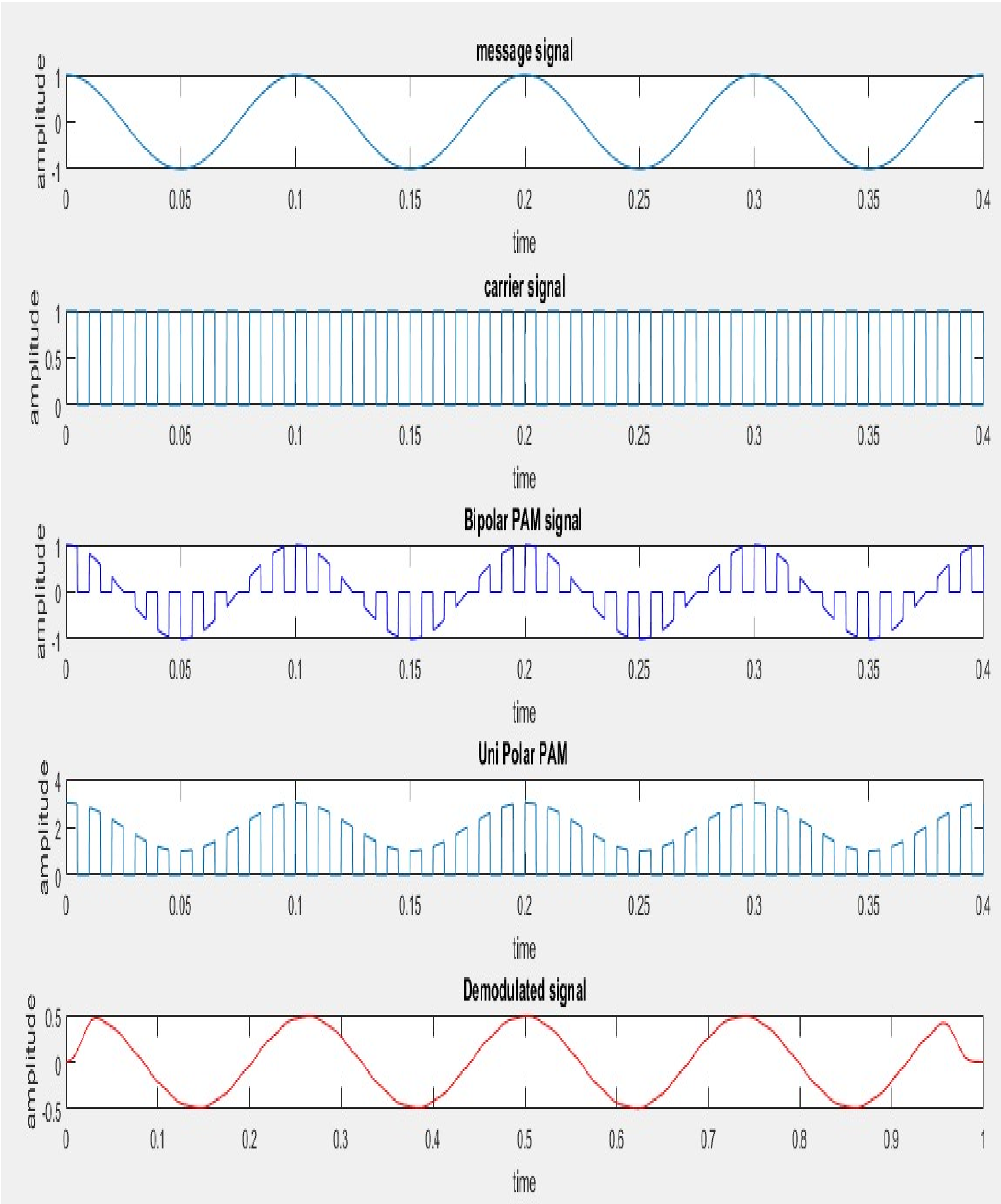
5.PROGRAM

```
%PAM
clc;
 clear all;
 close all;
%This program simulates the generation and demodulation of  Pulse amplitude
modulated signal.
```

```
fc=100;
fm=fc/10;
fs=100*fc;
t=0:1/fs:4/fm;
mt=cos(2*pi*fm*t);
ct=0.5*square(2*pi*fc*t)+0.5;
st=mt.*ct;
tt=[ ];
%single sided PAM
fori=1:length(st);
ifst(i)==0;
tt=[tt,st(i)];
else
tt=[tt,st(i)+2];
end
end
figure(1)
subplot(5,1,1);
plot(t,mt);
title('message signal');
xlabel('time');
ylabel('Amplitude');
subplot(5,1,2);
plot(t,ct);
title('carrier signal');
xlabel('timeperiod');
ylabel('Amplitude');
subplot(5,1,3);
plot(t,st);
title('Bipolar PAM signal ');
xlabel('time');
ylabel('Amplitude');
subplot(5,1,4);
plot(t,tt);
title('Uni Polar PAM ');
xlabel('time');
ylabel('Amplitude');
%demodulation
dt=st.*ct;
dt_frequency=fftshift(abs(fft(dt)));
filter=fir1(200,fm/fs,'low');
original_t_signal=conv(filter,dt);
original_f_signal=fftshift(abs(fft(original_t_signal)));
t1=0:1/(length(original_t_signal)-1):1;
f=-fs/2:fs/(length(original_f_signal)-1):fs/2;
subplot(5,1,5)
plot(t1,original_t_signal);
```

```
title('Demodulated signal');
xlabel('time');
ylabel('Amplitude');
```

6.MODEL WAVEFORMS:



7.PRECAUTIONS:

1. Check out source file is with '.m' extension or not.
2. The file name should begin with character and should not contain any punctuation marks.
3. File name should not be any in built in function name or any keyword
4. Save the .m files preferably in work folder of MATLAB .
5. Don't delete any file or folder without informing the system administrator or lab in-charge.

8.RESULT: Pulse Amplitude Modulation & Demodulation is simulated using MATLAB

Pulse Time Modulation & Demodulation	EXPT. NO : 12(a)
	DATE :

1.AIM:

To simulate Pulse Width Modulation & Demodulation using MATLAB

2.EQUIPMENT REQUIRED:

1. Personal Computer.
2. MATLAB Version 9.1

3.THEORY: Pulse-width modulation (PWM), or pulse-duration modulation (PDM), is a fancy way of describing a digital (binary/discrete) signal that was created through a modulation technique, which involves encoding a message into a pulsing signal. Although this modulation technique can be used to encode information for transmission, its main use is to allow the control of the power supplied to electrical devices, especially to inertial loads such as motors. In addition, PWM is one of the two principal algorithms used in photovoltaic solar battery chargers, the other being maximum power point tracking.

4.PROCEDURE:-

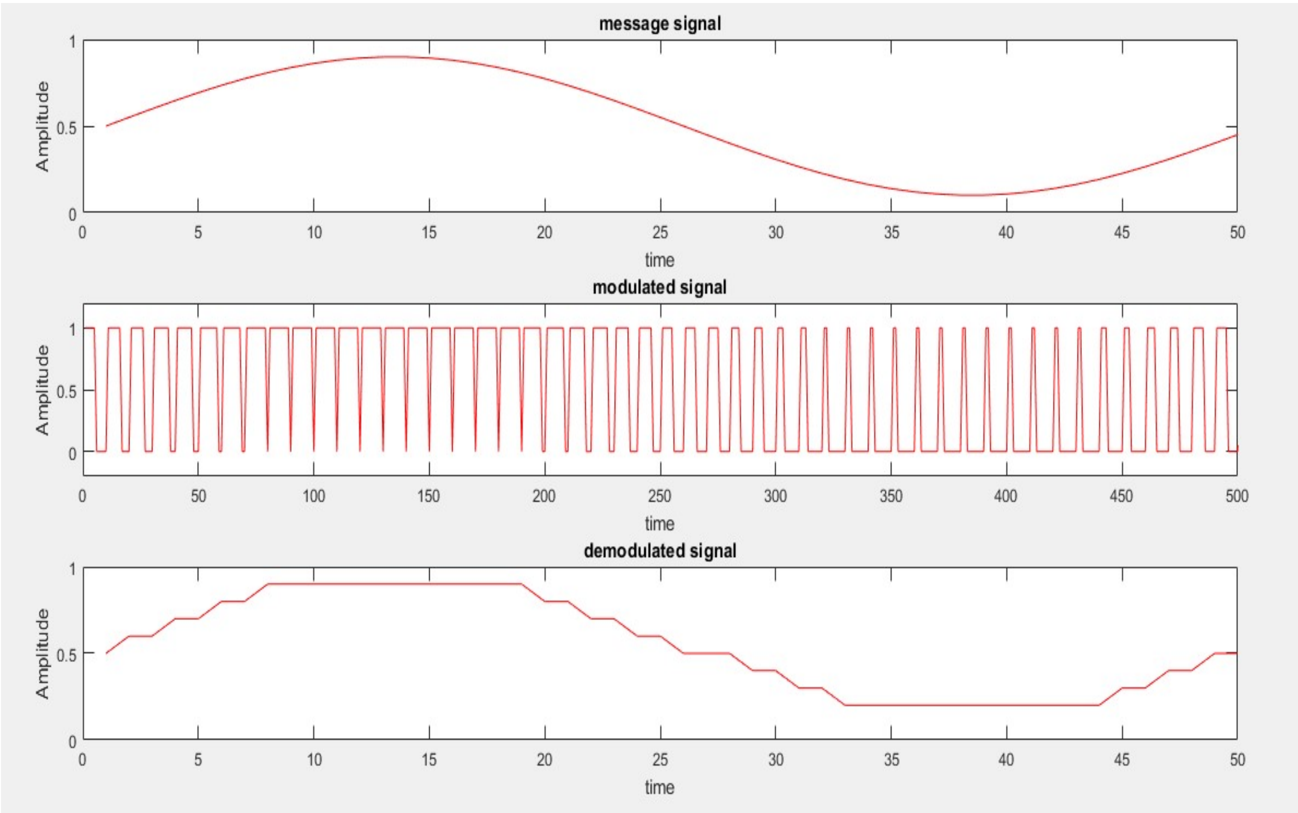
1. Open the MATLAB software by double clicking the icon on desktop.
2. Open the new M-file by using file menu.
3. Write the program in new file.
4. Click on save with .m extension and execute using run the icon.
5. Perform error check which displayed on command window.
6. Plot the waveforms displayed on figure window.
7. Note down the values, which are displayed on the command window.

5.PROGRAM:

```
clc;
clear all;
close all;
%This program simulates the generation and demodulation of Pulse width modulated signal.
fc=1000;
fs=10000;
fm=200;
t=0:1/fs:(2/fm-1/fs);
mt=0.4*sin(2*pi*fm*t)+0.5;
st=modulate(mt,fc,fs,'PWM');
dt=demod(st,fc,fs,'PWM');
```

```
figure
subplot(3,1,1);
plot(mt,'r');
title('message signal');
xlabel('time');
ylabel('amplitude');
axis([0 50 0 1])
subplot(3,1,2);
plot(st,'r');
title('modulated signal');
xlabel('time');
ylabel('amplitude');
axis([0 500 -0.2 1.2])
subplot(3,1,3);
plot(dt,'r');
title('demodulated signal');
xlabel('time');
ylabel('amplitude');
axis([0 50 0 1])
```

6.MODEL WAVE FORMS:



7.PRECAUTIONS:

1. Check out source file is with '.m' extension or not.
2. The file name should begin with character and should not contain any punctuation marks.
3. File name should not be any in built in function name or any keyword
4. Save the .m files preferably in work folder of MATLAB .
5. Don't delete any file or folder without informing the system administrator or lab in-charge.

8.RESULT: Pulse Width Modulation & Demodulation is implemented by using MATLAB

12.Pulse Time Modulation & Demodulation	EXPT. NO : 12(b)
	DATE :

1.AIM:

To implement Pulse Position Modulation & Demodulation using MATLAB

2.EQUIPMENT REQUIRED:

1. Personal Computer.
2. MAT Lab Version 9.1

3.THEORY: In PPM the amplitude and width of the pulses is kept constant but the position of each pulse is varied accordance with the amplitudes of the sampled value of the modulating signal. The position of the pulses is changed with respect to the position of reference pulses. The PPM pulses can be derived from the PWM pulses. With the increase in the modulating voltage the PPM pulse shift further with respect to reference.

4.PROCEDURE:-

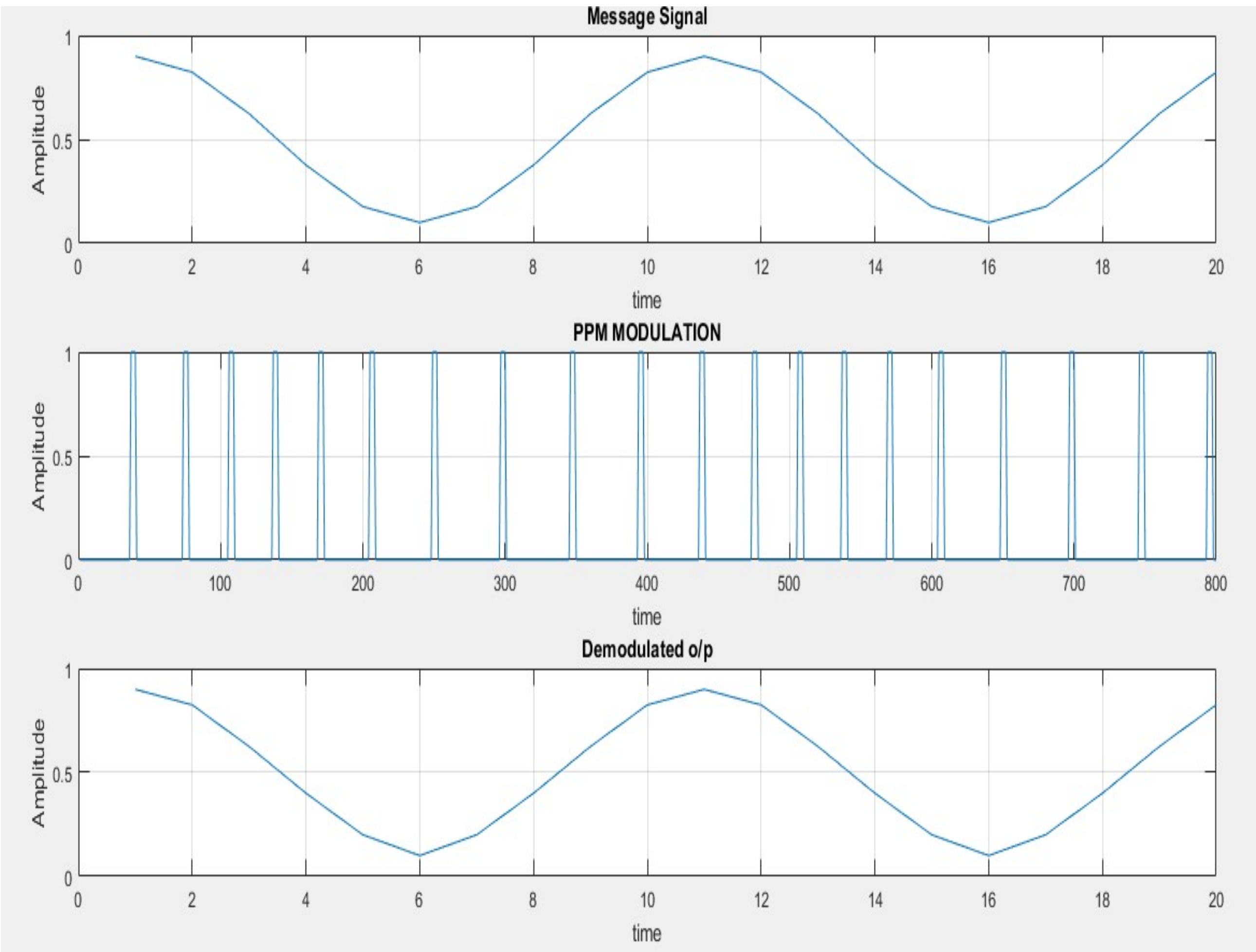
1. Open the MATLAB software by double clicking the icon on desktop.
2. Open the new M-file by using file menu.
3. Write the program in new file.
4. Click on save and run the icon.
5. Perform error check which displayed on command window.
6. Plot the waveforms displayed on figure window.
7. Note down the values, which are displayed on the command window.

5.PROGRAM:

```
clc
clear all;
close all;
%This program simulates the generation and demodulation of Pulse position
        modulated Signal
fc=50;
fs=2000;
f1=200;f2=300;
t=0:1/fs:((2/f1)-(1/fs));
x1=0.4*cos(2*pi*f1*t)+0.5;
subplot(311);
plot(x1);
```

```
title('Message Signal');
 xlabel('time')
 ylabel('Amplitude')
grid;
subplot(312);
y=modulate(x1,fc,fs,'ppm');
plot(y);
title('PPM MODULATION');
 xlabel('time')
 ylabel('Amplitude')
grid;
 z=demod(y,fc,fs,'ppm');
subplot(313);
plot(z);
title('Demodulated o/p');
xlabel('time')
 ylabel('Amplitude')
grid;
```

6.MODEL WAVEFORMS:



7.PRECAUTIONS:

1. Check out source file is with '.m' extension or not.
2. The file name should begin with character and should not contain any punctuation marks.
3. File name should not be any in built in function name or any keyword
4. Save the .m files preferably in work folder of MATLAB .
5. Don't delete any file or folder without informing the system administrator or lab in-charge.

8.RESULT : Pulse Position Modulation & Demodulation is simulated by using MATLAB

Experiments beyond syllabus

Construct a signal flow graph for generating Amplitude modulated Signal using GNU Radio.	EXPT. NO : 1
	DATE :

1. AIM:

To construct a signal flow graph for generating Amplitude modulated Signal using GNU Radio.

2.COMPONENTS & TOOLS REQUIRED:

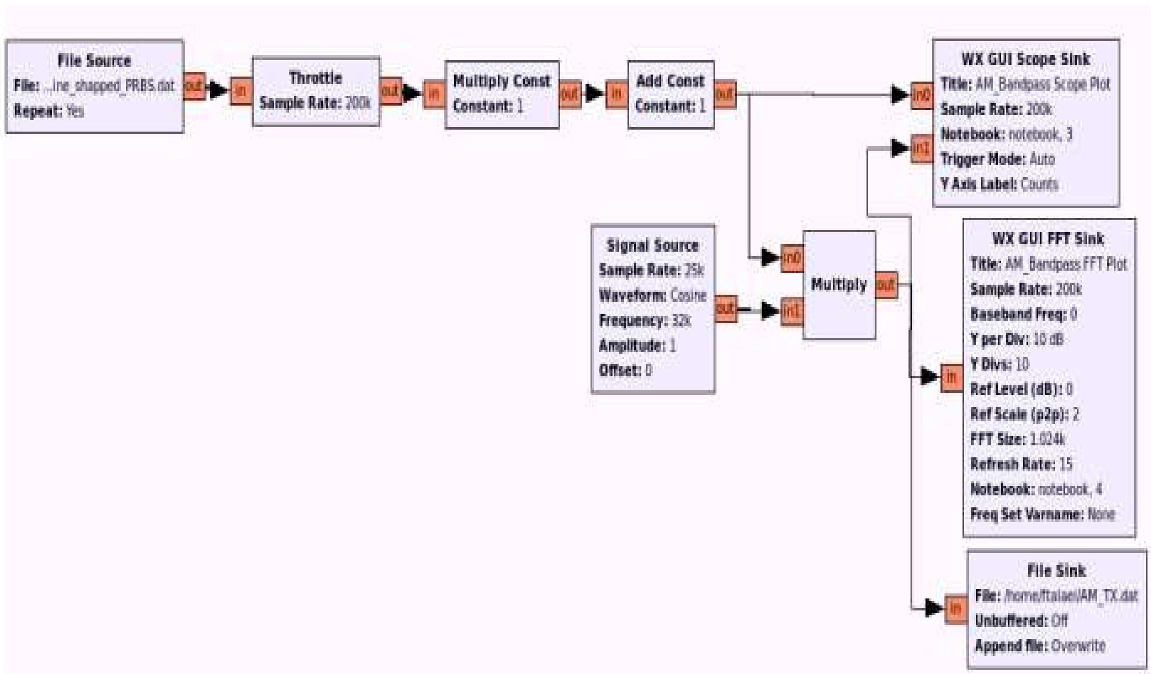
1. GNU Radio 3.7
2. Personal Computer

3. THEORY:

GNU Radio is a free software development toolkit that provides signal processing blocks to implement software-defined radios and signal-processing systems. It can be used with external RF hardware to create software-defined radios, or without hardware in a simulation-like environment. It is widely used in hobbyist, academic, and commercial environments to support both wireless communications research and real-world radio system. The GNU Radio software provides the framework and tools to build and run software radio or just general signal-processing applications. The GNU Radio applications themselves are generally known as "flowgraphs", which are a series of signal processing blocks connected together, thus describing a data flow.

As with all software-defined radio systems, reconfigurability is a key feature. Instead of using different radios designed for specific but disparate purposes, a single, general-purpose, radio can be used as the radio front-end, and the signal-processing software (here, GNU Radio), handles the processing specific to the radio application.

4.SIGNAL FLOW GRAPH:



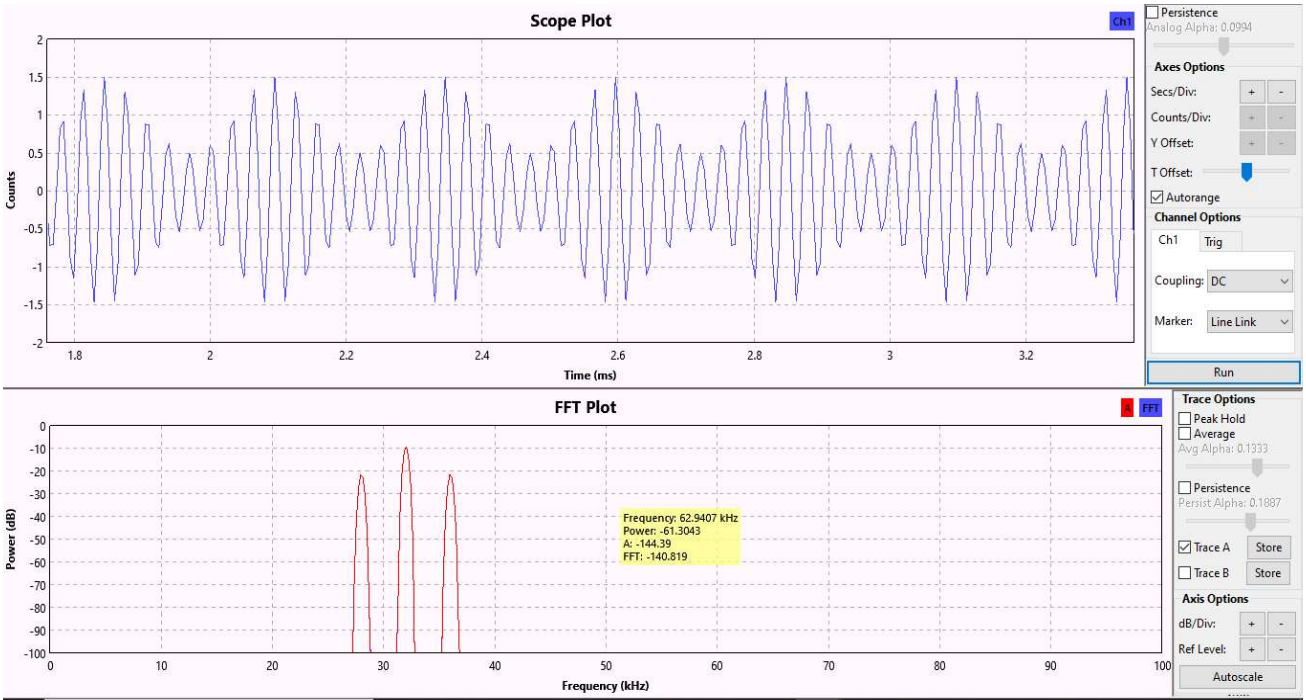
5.PROCEDURE:

1. Open the GNU Radio Companion.
2. Create new WX GUI.
3. Construct the signal flow graph by means of drag and drop from the available modules.
4.Give connections and run the flow graph
5. Plot the waveforms displayed on figure window.

6.PRECAUTIONS:

1. Check whether source file is with '.gnu' extension or not.
2. The file name should begin with character and should not contain any punctuation marks.
3. File name should not be any in built in function name or any keyword
4. Don't delete any file or folder without informing the system administrator or lab in-charge.
5. Choose the data type to be float in all the modules used.

7.MODEL WAVEFORMS:



8.RESULT: Signal Flow graph is constructed using GNU Radio and Amplitude Modulation is Simulated.

Construct a signal flow graph for generating Frequency modulated Signal using GNU Radio.	EXPT. NO : 2
	DATE :

1. AIM:

To construct a signal flow graph for generating Frequency modulated Signal using GNU Radio.

2.COMPONENTS & TOOLS REQUIRED:

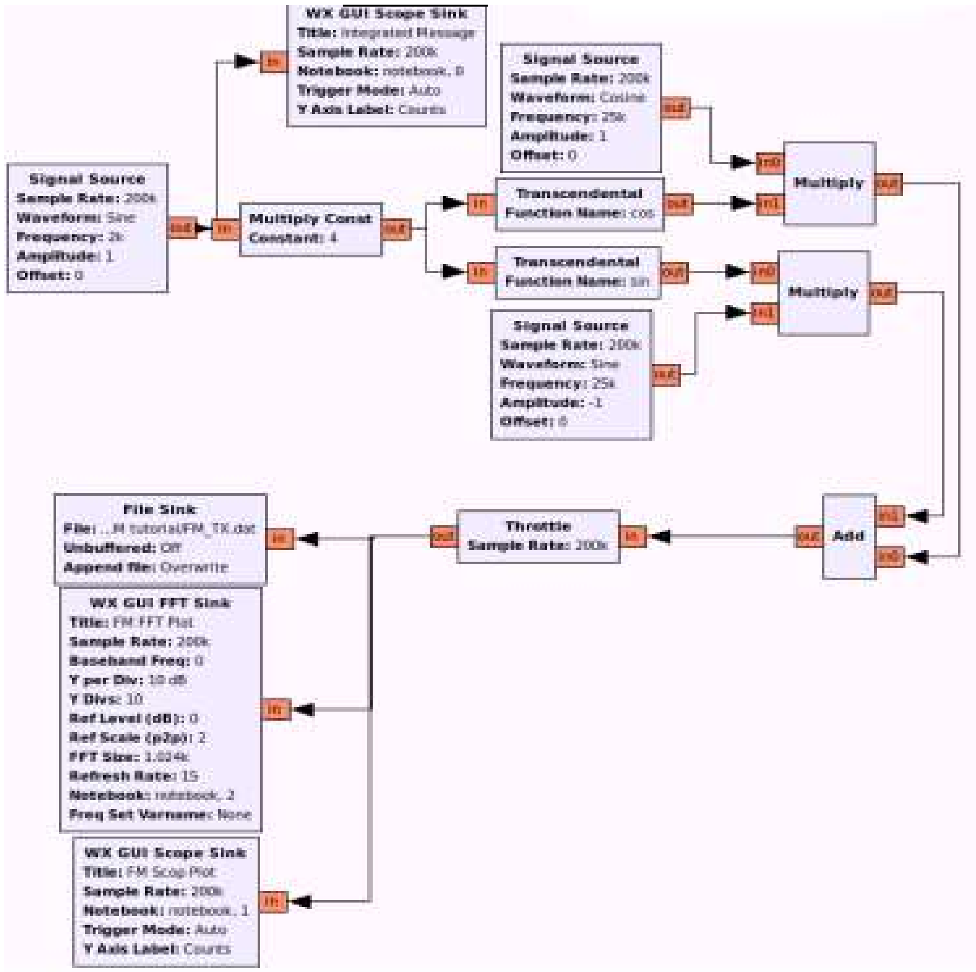
1. GNU Radio 3.7
2. Personal Computer

3. THEORY:

GNU Radio is a free software development toolkit that provides signal processing blocks to implement software-defined radios and signal-processing systems. It can be used with external RF hardware to create software-defined radios, or without hardware in a simulation-like environment. It is widely used in hobbyist, academic, and commercial environments to support both wireless communications research and real-world radio system. The GNU Radio software provides the framework and tools to build and run software radio or just general signal-processing applications. The GNU Radio applications themselves are generally known as "flowgraphs", which are a series of signal processing blocks connected together, thus describing a data flow.

As with all software-defined radio systems, reconfigurability is a key feature. Instead of using different radios designed for specific but disparate purposes, a single, general-purpose, radio can be used as the radio front-end, and the signal-processing software (here, GNU Radio), handles the processing specific to the radio application.

4.SIGNAL FLOW GRAPH:



5.PROCEDURE:

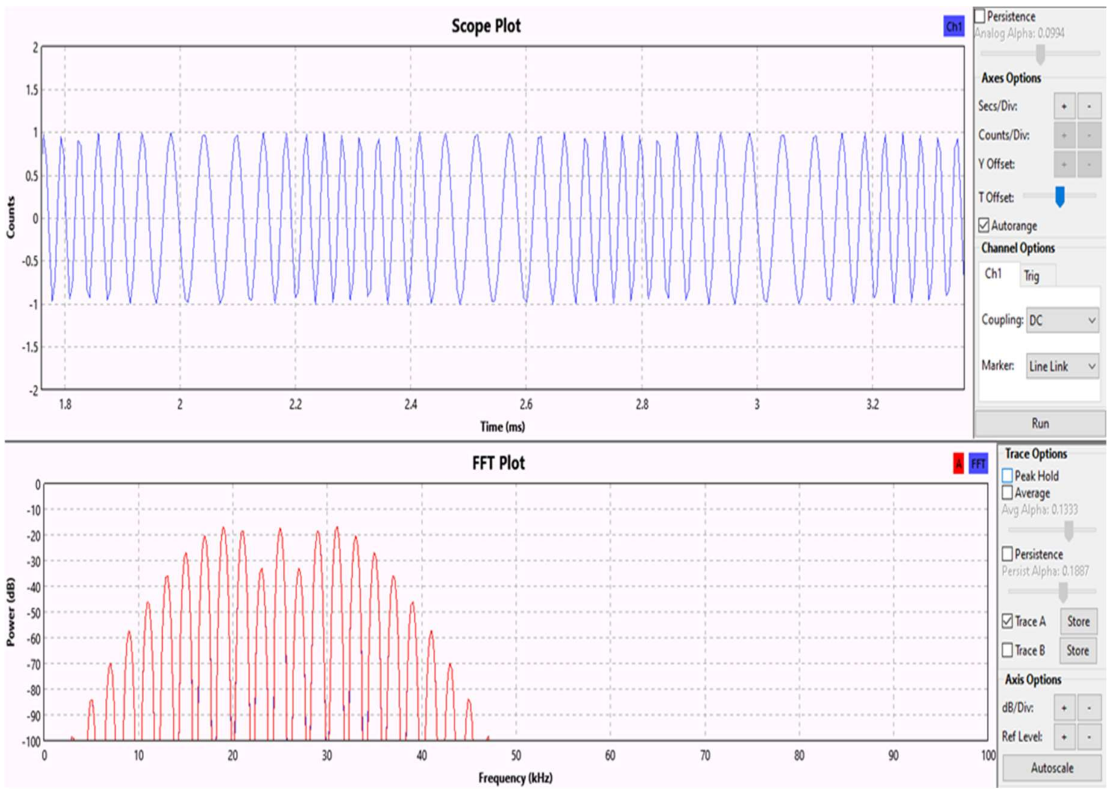
1. Open the GNU Radio Companion.
2. Create new WX GUI.
3. Construct the signal flow graph by means of drag and drop from the available modules.
4. Give connections and run the flow graph
5. Plot the waveforms displayed on figure window.

6.PRECAUTIONS:

1. Check whether source file is with '.gnu' extension or not.
2. The file name should begin with character and should not contain any punctuation marks.
3. File name should not be any in built in function name or any keyword

4. Don't delete any file or folder without informing the system administrator or lab in-charge.
5. Choose the data type to be float in all the modules used.

7.MODEL WAVEFORMS:



8.RESULT: Signal Flow graph is constructed using GNU Radio and Frequency Modulation is Simulated.