LABORATORY MANUAL

ANALOG COMMUNICATIONS

III B.TECH -I Semester (ECE)

A.Y-2017-18

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INSTITUTE OF TECHNOLOGY & MANAGEMENT
(Approved by AICTE-New Delhi, Accredited by NAAC with 'A' & Affliated to JNTU, Hyderabad)
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LIST OF EXPERIMENTS
ANALOG COMMUNICATIONS LAB

AMPLITUDE MODULATION AND DEMODULATION	EXPT. NO: 1
	DATE:

1. AIM:

1.1 To study the amplitude modulation and demodulation for different modulation index.

2. COMPONENTS & TOOLS REQUIRED:

2. 1. Audio signal generator

2. 2. Carrier generator

2. 3. Amplitude Modulator Trainer Kit

2. 4. Cathode Ray Oscilloscope (30 MHz).

2.5. Connecting wires

3. THEORY:

Modulation is defined as process in which changing the characteristics usually amplitude, frequency and phase of high frequency wave (Carrier wave) by using instantaneous values of the low frequency signal (modulating signal).

Need for modulation:

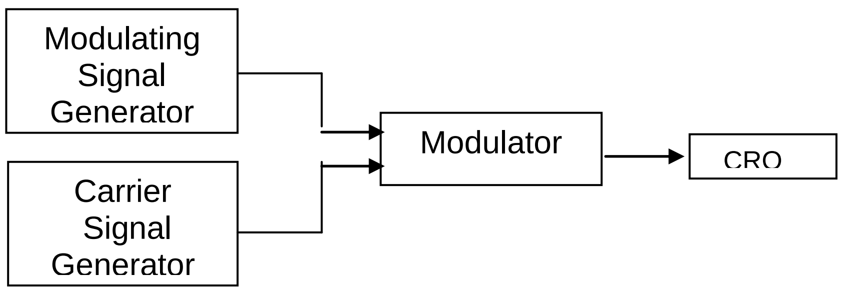
3.1.1 Antenna height and operating frequencies are related each other. So antenna heights are comparable to the quarter wavelengths. For usual audio frequencies antenna heights are unthinkable and impracticable.

3.1.2 Audio frequencies are directly transmitted when there is a possibility of mixing with the other frequencies in near by station.

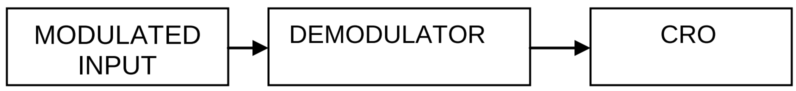
3.1.3 If high frequency signals are directly transmitted there is no varying parameter compared to the audio frequency Amplitude modulation is defined as the process in which changing the amplitude of the Carrier wave by using the instantaneous voltages of the modulating signal. In this carrier Signal frequency remains constant

4. BLOCK DIAGRAM:

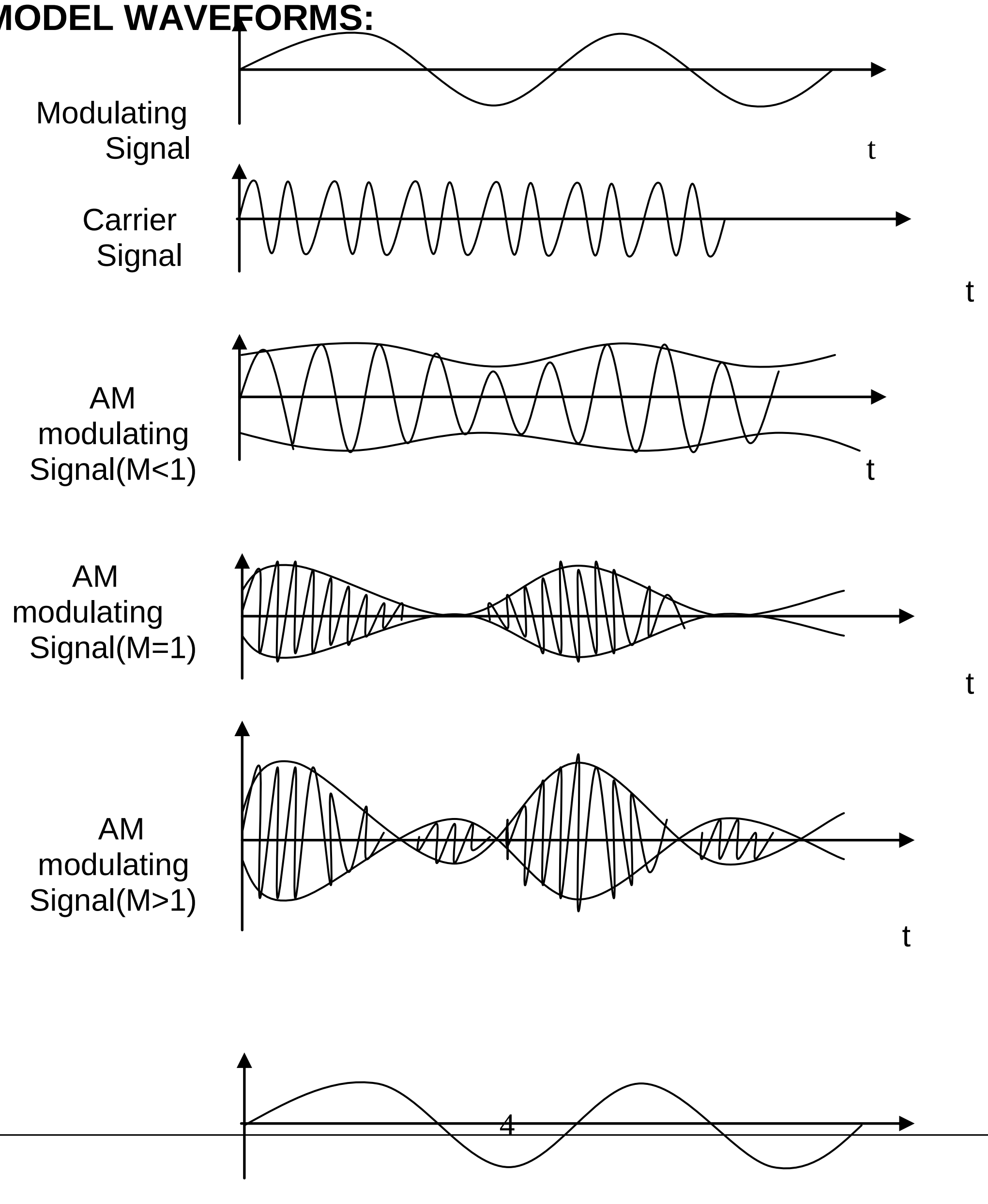
MODULATOR:



DEMODULATOR:



5. MODEL WAVEFORMS:



De modulated

Signal t

6. EXPERIMENTAL PROCEDURE:

6.1 Switch on the power supply through mains card.

6.2 Observe the modulating signal on CRO and set the modulating voltage to 2 V and frequency to 1.56 KHz.

6.3 Observe the carrier signal on CRO and set the carrier voltage to 2.6 V and frequency to 166.66 KHz.

6.4 Connect the carrier and modulating signal's to modulator and also connects the output of modulator to CRO and note down the waveforms.

6.5 Find out the maximum and minimum voltages from CRO and from these values Calculate modulation index by using the above formula.

6.6 Repeating the above procedure for different modulation index and draw the waveforms.

6.7 Connect the amplitude modulated signal to the demodulator

6.8 Connect the CRO across the out put terminals of the demodulator

6.9 Observe the waveforms the modulating signal for different modulation 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:

8.1 Amplitude of modulating signal_____________

8.2 Frequency of modulating signal______________

8.3 Amplitude of carrier signal_________________

8.4 Frequency of carrier signal_________________

8.5 Amplitude of demodulating signal___________

8.6 Frequency of demodulating signal___________

9. CONCLUSION:

For various modulation indices the amplitude modulation and de-modulation is verified.

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?
6. Define Amplitude Modulation index?
7. Define percentage Modulation and What are the units of amplitude sensitivity?
8. What is the need for modulation index?
9. What is the need for modulation?
10. What is the percentage of carrier in AM?

11. APPLICATIONS

AM was the earliest modulation method used to transmit voice by radio. It remains in use today in many forms of communication; for example it is used in portable two way radios, VHF aircraft radio, Citizen's Band Radio and in computer modems. "AM" is often used to refer to medium wave AM radio broadcasting.

AMPLITUDE MODULATION AND DEMODULATION

AIM:

To generate Amplitude Modulation using MATLAB Software for different modulation indices.

APPARATUS REQUIRED:

1. Computer

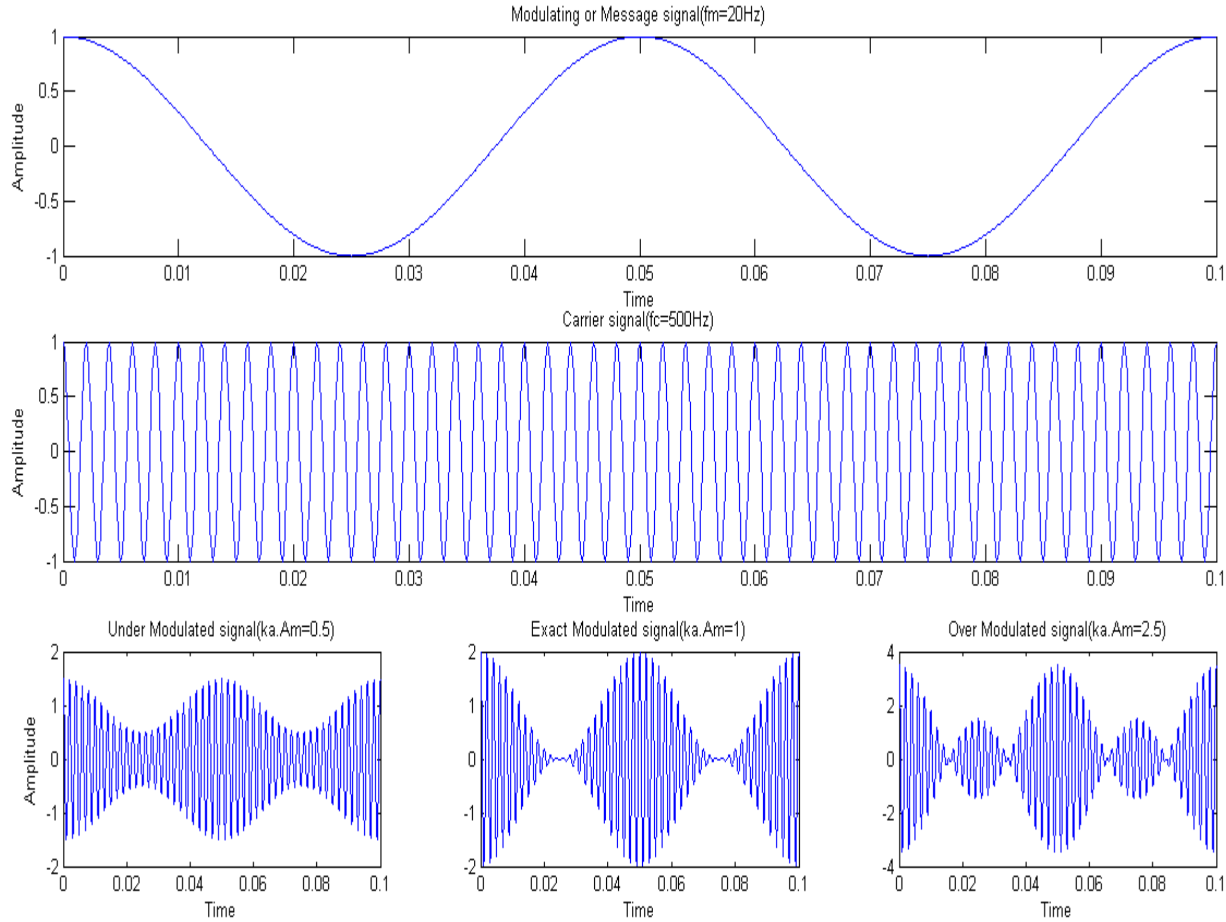
2. MATLAB

PROGRAM:

```
fs=8000;
fm=20;
fc=500;
Am=1;
Ac=1;
t=[0:.1*fs]/fs;
m=Am*cos(2*pi*fm*t);
c=Ac*cos(2*pi*fc*t);
ka=0.5;
u=ka*Am;
s1=Ac*(1+u*cos(2*pi*fm*t)).*cos(2*pi*fc*t);
subplot(4,3,1:3);
plot(t,m);
title('Modulating or Message signal(fm=20Hz)');
subplot(4,3,4:6);
plot(t,c);
title('Carrier signal(fc=500Hz)');
subplot(4,3,7);
plot(t,s1);
title('Under Modulated signal(ka.Am=0.5)');
Am=2;
ka=0.5;
u=ka*Am;
s2=Ac*(1+u*cos(2*pi*fm*t)).*cos(2*pi*fc*t);
subplot(4,3,8);
plot(t,s2);
title('Exact Modulated signal(ka.Am=1)');
Am=5;
ka=0.5;
u=ka*Am;
s3=Ac*(1+u*cos(2*pi*fm*t)).*cos(2*pi*fc*t);
subplot(4,3,9);
plot(t,s3);
title('Over Modulated signal(ka.Am=2.5)');
r1= s1.*c;
[b a] = butter(1,0.01);
mr1= filter(b,a,r1);
subplot(4,3,10);
plot(t,mr1);
r2= s2.*c;
```

```
[b a] = butter(1,0.01);
mr2= filter(b,a,r2);
subplot(4,3,11);
plot(t,mr2);
r3= s3.*c;
[b a] = butter(1,0.01);
mr3= filter(b,a,r3);
subplot(4,3,12);
plot(t,mr3);
```

Simulated Wave forms for AM



INFERENCE:
Amplitude modulated wave is observed for different modulation indices

EXERCISE:

1) Generate an AM wave with message signal 2cos(πt) and carrier -4Sin(1000πt) with amplitude sensitivity K_a= 0.3.
2) Generate an AM wave with message signal 2cos(πt) and carrier -4Sin(1000πt +10) with amplitude sensitivity K_a= 0.5
3) Generate an AM wave with message signal 2cos(πt+5) and carrier -4Sin(1000πt) with amplitude sensitivity K_a= 0.75
4) Generate an AM wave with message signal 2cos(πt+5) and carrier -4Sin(1000πt+10) with amplitude sensitivity K_a= 0.5

5) Generate an AM wave with message signal 5Sin(10πt+10) and carrier 10Sin(10000πt) with amplitude sensitivity K_a= 0.25
6) Generate an AM wave using in-built functions in MATLAB for under modulation.
7) Generate an AM wave using in-built functions in MATLAB for perfect modulation.
8) Generate an AM wave using in-built functions in MATLAB for over modulation.
9) Generate an AM wave with message signal 2cos(πt+5) and carrier 4Sin(1000πt+10) with amplitude sensitivity K_a= 0.56
10) Generate an AM wave with message signal 5Sin(10πt+10) and carrier 10Sin(10000πt) with amplitude sensitivity K_a= 0.45
11) Generate an AM wave with message signal 4cos(2πt) and carrier 4Sin(1000πt) with amplitude sensitivity K_a= 0.3.
12) Generate an AM wave with message signal 2cos(5πt) and carrier -4Sin(2000πt +10) with amplitude sensitivity K_a= 0.5
13) Generate an AM wave with message signal 4cos(4πt+5) and carrier 4Sin(5000πt) with amplitude sensitivity K_a= 0.75
14) Generate an AM wave with message signal 2cos(6πt+5) and carrier 4Sin(1000πt+10) with amplitude sensitivity K_a= 1
15) Generate an AM wave with message signal 5Sin(20πt+10) and carrier 10Sin(20000πt) with amplitude sensitivity K_a= 0.2
16) Generate an AM wave using in-built functions in MATLAB for under modulation.
17) Generate an AM wave with message signal 20cos(10πt+5) and carrier -4Sin(2000πt+10) with amplitude sensitivity K_a= 0.7
18) Generate an AM wave with message signal 50Sin(100πt+10) and carrier 100Sin(20000πt) with amplitude sensitivity K_a= 0.6
19) Generate an AM wave with message signal 20cos(20πt+10) and carrier -4Sin(2000πt+10) with amplitude sensitivity K_a= 0.7
20) Generate an AM wave with message signal 50Sin(100πt+20) and carrier 100Sin(20000πt) with amplitude sensitivity K_a= 0.6
21) Generate an AM wave using in-built functions in MATLAB for over modulation.
22) Generate an AM wave with message signal 50cos(10πt+20) and carrier -12Sin(500πt+10) with amplitude sensitivity K_a= 0.5
23) Generate an AM wave with message signal 100Sin(100πt+10) and carrier 50Sin(30000πt) with amplitude sensitivity K_a= 0.8
24) Generate an AM wave with message signal 10cos(20πt+10) and carrier -40Sin(2000πt+10) with amplitude sensitivity K_a= 0.9
25) Generate an AM wave with message signal 5Sin(100πt+20) and carrier 10Sin(10000πt) with amplitude sensitivity K_a= 0.3

DOUBLE SIDE BAND MODULATION AND DEMODULATION	EXPT. NO: 2
	DATE:

1. AIM:

1.1 To study the DSB – SC Modulation using balance modulator

2. COMPONENTS & TOOLS REQUIRED:

2. 1. Audio signal generator

2. 2. Carrier generator

2. 3. Balanced modulator Trainer Kit

2. 4. Cathode Ray Oscilloscope.

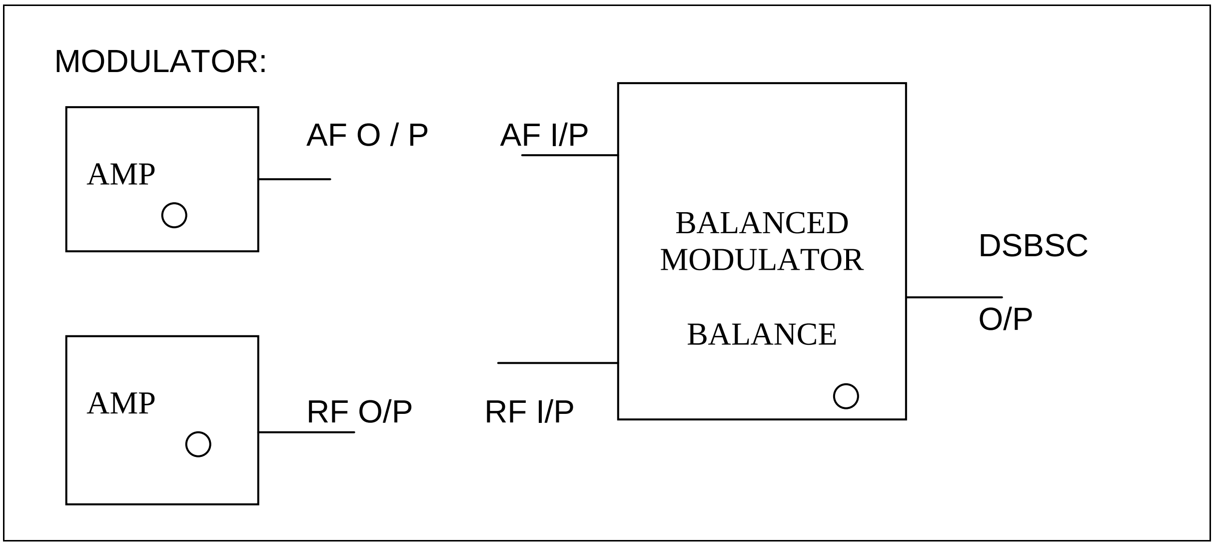
2.5. Connecting wires

3. THEORY:

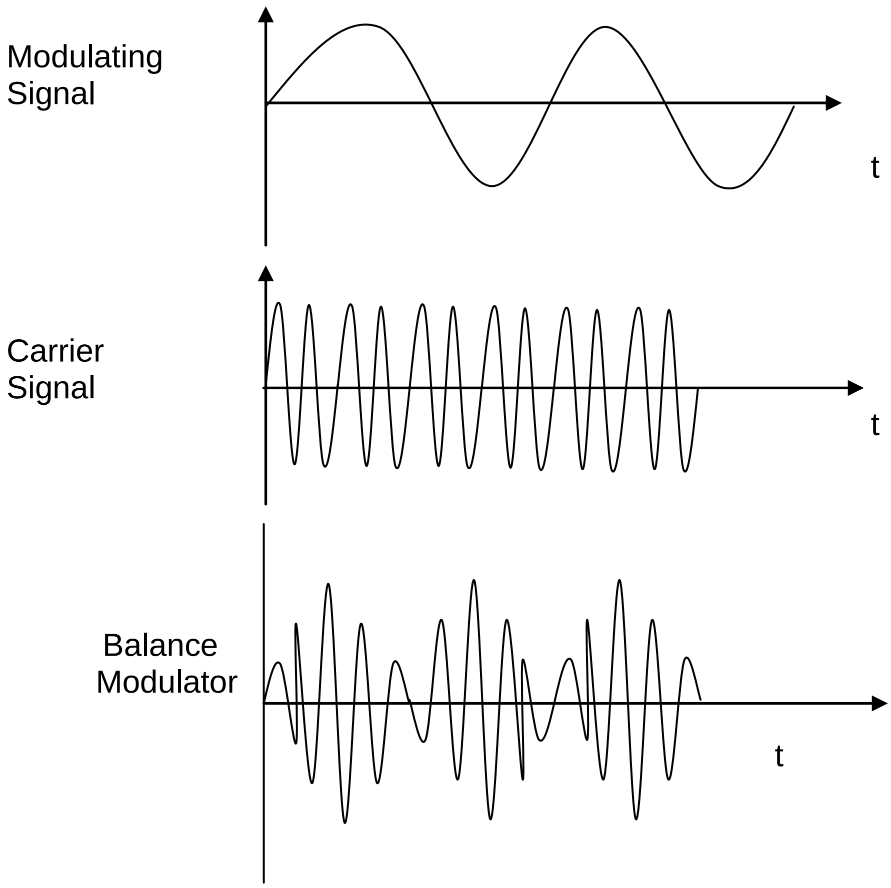
Balance modulator is used for generation of double side band suppress carrier signal. The output of balanced modulator is equal to the product of applied input signals. In order to generate this it uses the non-linear characteristics of semi conductor device. Since the carrier does not convey any information, 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.

Balance modulator is also used in generation of SSB signals. The modulated signal undergoes a phase reversal whenever the base band signal crosses zero. Unlike AM, The envelope of DSBSC id different from base band signal. The ring modulator is another circuit for generating the DSBSC signal.

4. BLOCK DIAGRAM:



5. MODEL WAVEFORMS:



6. EXPERIMENTAL PROCEDURE:

6.1 Switch on the power supply through mains card.

6.2 As the circuitry is already wired, you just have to trace the circuit according to the circuit diagram.

6.3 Connect 5 KHz sinusoidal signal to both the carrier and modulation inputs.

6.4 Observe the output on CRO and adjust the null potentiometer until the output is 10 KHz sinusoidal wave. Note that this is very sensitive adjustment because you are making the biasing at both inputs exactly the same to get the multiplying effect of the device.

6.5 Apply a 100 KHz, 0.1 v – peak sinusoidal wave to the carrier input and a 5 KHz sinusoidal wave with 0.1v peak to the modulation input.

6.6 Adjust carrier null potentiometer to obtain a DSBSC wave as output Vary the amplitude frequency of the message signals at different levels.

6.7 Observe the variation in side bands and suppression of carrier.

6.8 Record the exact frequency levels of side bands suppressed carrier from CRO.

8. 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:

8.1 Amplitude of modulating signal ------------------------------

8.2 Frequency of modulating signal-------------------------------

8.3 Amplitude of carrier signal ------------------------------------

8.4 Frequency of carrier signal ------------------------------------

8.5 Frequency of Balanced detector output signal---------------

9. CONCLUSION:

The output waveform of balanced modulator is observed and plotted.

10. VIVA -VOCE QUESTIONS:

10.1 What is the significance of the balanced modulator?

10.2 What is the disadvantage of DSB-FC?

10.3 What is the percentage of power saving in DSB-SC over DSB-FC?

10.4 What is the bandwidth required for the transmission of DSB-SC signals?

10.5 Which detector is used for detecting the DSB-SC signals?

10.6 Why there is a phase reversal in DSB-SC wave?

10.7 Define DSB-SC over AM.

10.8 Write the power relation equation for DSB-SC?

10.9 What are the applications of DSB-SC?

10.10 Write the equation for DSB-SC in Time & Frequency domain?

11. APPLICATIONS: DSB-SC transmission is a special case of double-sideband reduced carrier transmission. It is used for radio data systems

EXPERIMENT NO: 2
DSB-SC MODULATION & DETECTION

AIM:

To generate DSBSC wave Modulation using MATLAB Software.

APPARATUS REQUIRED:

1. Computer

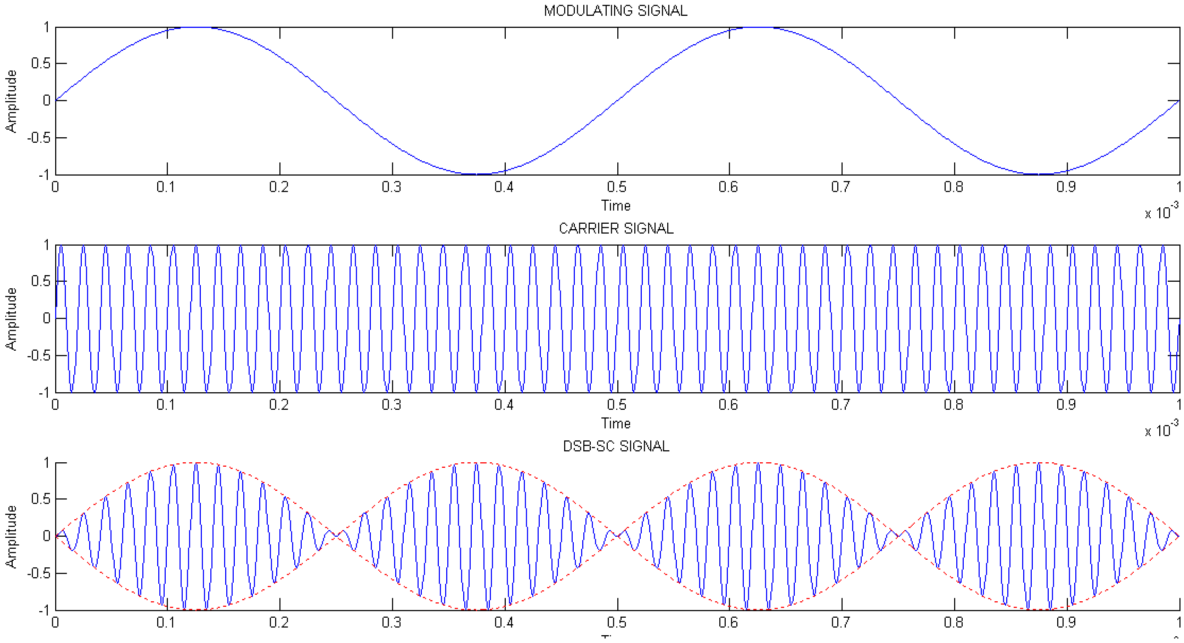
2. MATLAB software

PROGRAM:

```
t =0:0.000001:.001;
Vm= 1;
Vc= 1;
fm = 2000;
fc= 50000;
m_t = Vm*sin(2*pi*fm*t);
subplot(4,1,1);
plot(t,m_t);
c_t = Vc*sin(2*pi*fc*t);
subplot(4,1,2);
plot(t,c_t);
subplot(4,1,3);
s_t = m_t.*c_t;
hold on;
plot(t,s_t);
```

```
plot(t,m_t,'r:');
plot(t,-m_t,'r:');
hold off;
r = s_t.*c_t;
[b a] = butter(1,0.01);
mr= filter(b,a,r);
subplot(4,1,4);
plot(t,mr);
```

Simulated Wave forms



INFERENCE:
DSB-SC modulated wave is observed using MATLAB software.

EXERCISE:

1) Generate DSBSC wave with message as 3Sin(2π5t) and carrier 6Sin(200πt).
2) Generate DSBSC wave with message as 3Cos(2π50t +10) and carrier 2Sin(1000πt)
3) Generate DSBSC wave with message as 3Sin(100πt) and carrier 6Sin(20000πt)
4) Generate DSBSC wave with message as 3Sin(10πt+5) and carrier 6Sin(1000πt+10)`
5) Demodulate the DSBSC wave 5[cos(150t)+cos(50t)]

6) Demodulate the DSBSC wave 5[cos(1050t)+cos(950t)]
7) Generate DSBSC wave with message as 5Sin(2πt) and carrier 10Sin(200πt).
8) Generate DSBSC wave with message as 5Cos(2π50t +10) and carrier 10Sin(1000πt)
9) Demodulate the DSBSC wave 4[cos(150t)+cos(50t)]
10) Demodulate the DSBSC wave 4[cos(1050t)+cos(950t)]
11) Generate DSBSC wave with message as 5Sin(2π5t) and carrier 7Sin(200πt).
12) Generate DSBSC wave with message as 10Cos(2π60t +20) and carrier 20Sin(2000πt)
13) Generate DSBSC wave with message as 30Sin(500πt) and carrier 60Sin(30000πt)
14) Generate DSBSC wave with message as 5Sin(100πt+10) and carrier 6Sin(5000πt+20)`
15) Demodulate the DSBSC wave 10[cos(550t)+cos(650t)]
16) Demodulate the DSBSC wave 50[cos(1200t)+cos(800t)]
17) Generate DSBSC wave with message as 50Sin(2π50t) and carrier 10Sin(2000πt).
18) Generate DSBSC wave with message as 5Cos(6π50t +20) and carrier 10Sin(1000πt)
19) Demodulate the DSBSC wave 4[cos(250t)+cos(150t)]
20) Demodulate the DSBSC wave 4[cos(1100t)+cos(900t)]
21) Generate DSBSC wave with message as 15Sin(2π50t) and carrier 20Sin(100πt).
22) Generate DSBSC wave with message as 50Cos(2π25t +15) and carrier 10Sin(500πt)
23) Demodulate the DSBSC wave 15[cos(200t)+cos(100t)]
24) Demodulate the DSBSC wave 4[cos(2050t)+cos(1000t)]
25) Generate DSBSC wave with message as 50Sin(2π5t) and carrier 17Sin(100πt).

SINGLE SIDE BAND MODULATION AND DEMODULATION	EXPT. NO: 3
	DATE:

1. AIM:

1.2 To study the SSB modulation and demodulation process.

2. COMPONENTS & TOOLS REQUIRED:

2.1 A.F. generator

2.2 R.F generator

2.3 Balanced modulator-1

2.4 Balance modulator-2

2.5 Summer and substractor

2.6 Synchronous detector

2.7 CRO

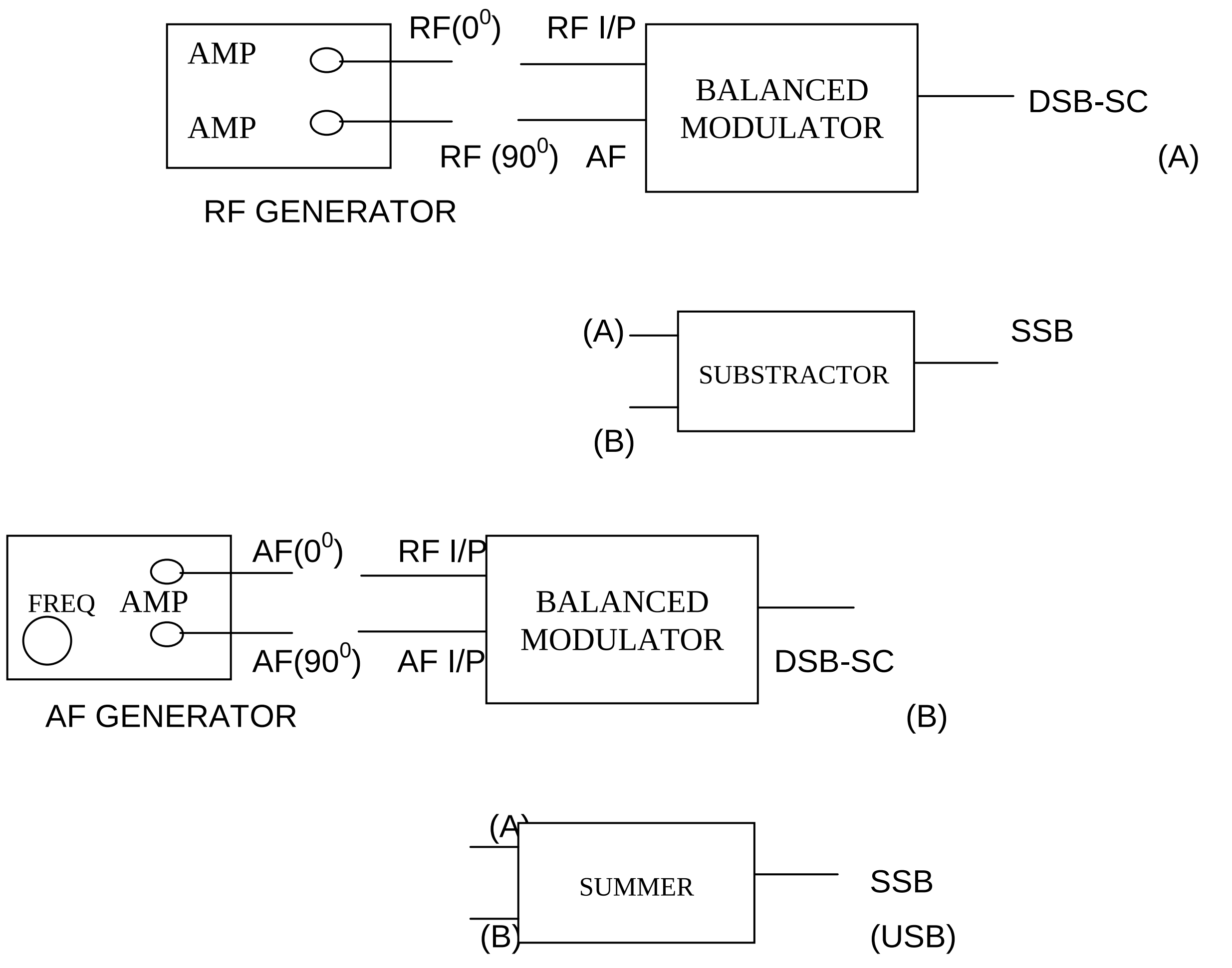
3. THEORY:

AM & DSB-SC both modulation techniques require bandwidth twice of the modulating signal bandwidth. Since two side bands having the same information. It is possible to recover the base band signal from any one of the side band, so only one side band is enough to give information without any loss of course the carrier is suppressed. Such transmission system is called single side band transmission system. SSB requires transmission bandwidth is equal to modulating signal bandwidth.

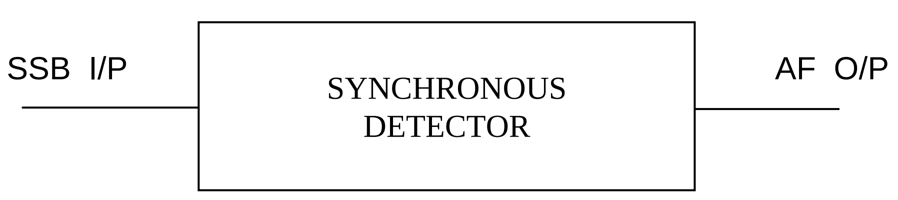
The reduced bandwidth also improves the SNR ratio and allows more no of channels in a given frequency. These advantage of SSB results in wide spread of SSB for aircrafts, transonic radio telephones, and mature radio communication systems.

4. BLOCK DIAGRAM:

MODULATOR:



DEMODULATOR:



4.1 BLOCK DIGRAM DISCRIPTION:

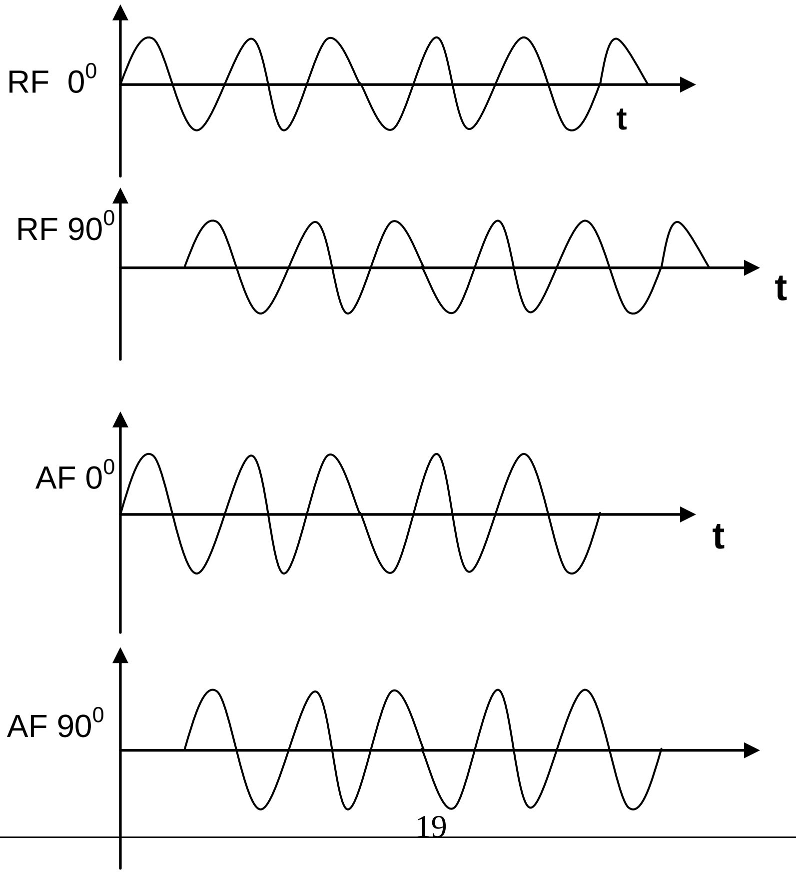
4.1.1 AF generator: It generates a low frequency (5KHZ) signal using Op-Amp based we in-bridge oscillator. TL-084 is a FET input general purpose Op-Amp integrated circuit. Potentiometer is provided to vary the output voltage of the oscillator.

4.1.2 RF generator: Collipits oscillator-using FET is used here to generate RF signal (100 KHZ frequency) to use as carrier signal. Adjustment for amplitude and frequency are provided.

4.1.3 Balanced Modulator: It has been developed using MC 1496 monolithic IC balanced modulator and demodulator. This can be up to 200 KGZ. This modulator is used to generate a DSB – SC signal. A null adjust is provided to suppress the carry.

4.1.4 Synchronous Detector: The base band signal can be uniquely recovered from the DSB-SC signal by multiplying with a locally generated sine carrier and then to a low pass filtering the product. The frequency and phase of local oscillator output signal must be equal to carrier signal. This type of coherent demodulation is called Synchronous detection. For demodulation also MC 1496 is used.

5. MODEL WAVEFORMS:



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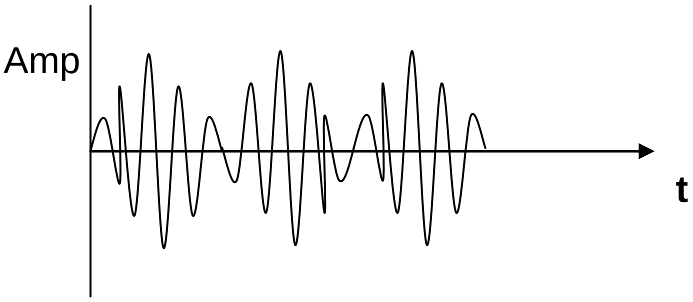
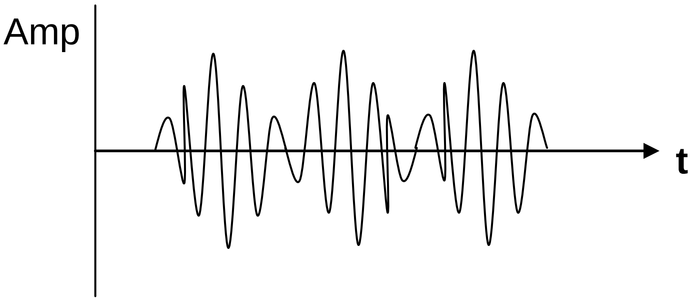
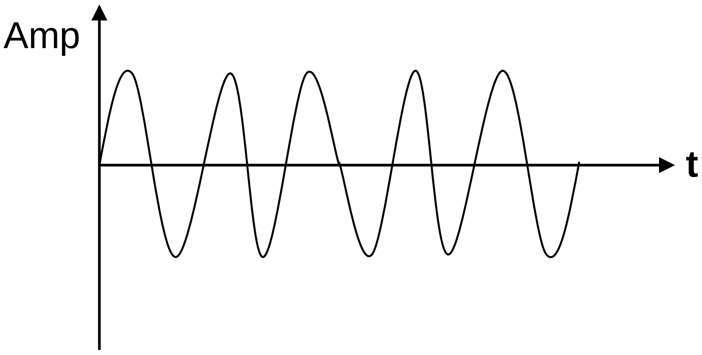
Balanced Modulator o/p - 1



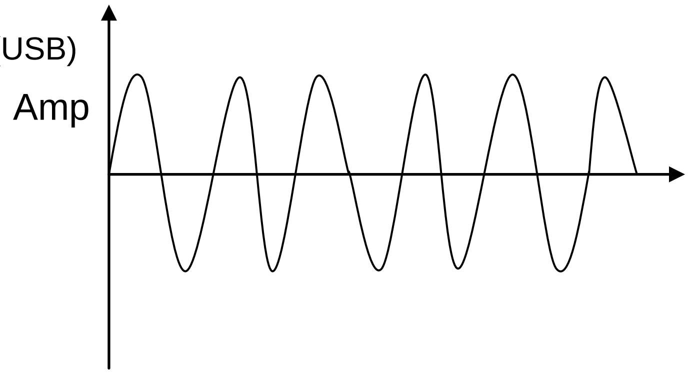
Balanced Modulator o/p - 2



SSB (LSB)



SSB (USB)



6. EXPERIMENTAL PROCEDURE:

6.1 Switch on the power supply through mains card.

6.2 As the circuitry is already wired, you just have to trace the circuit according to the circuit diagram.

6.3 Observe the output of the RF generator using CRO. Available two outputs of RF generator, one is 90° phase shift with other output of RF generator. The o/p frequency is set to 1000 KHZ and 0.1Vpp.

6.4 Similarly there are two o/p's available for AF generator also. One is direct output another one is 90° phase shift with direct output. Switch is provided to select 2k/4k/6kHz. AGC potentiometer is also provided for gain adjustment set the amplitude to 10Vpp.

6.5 Connect 0' phase shift RF generator output and 90° phase shift AF generator o/p are to a balanced modulator and reaming two o/p's are connected to other balanced modulator.

6.6 Observe the both balanced modulator outputs simultaneously on the CRO and adjust the balance control until you get the DSBSC wave on CRO. To get the SSB (LSB) signal connect balance modulator outputs to subs tractor and note down the frequency of SSB wave and compare this with theoretical value.

SSB (LSB) = RF frequency - AF Frequency

= 100KHZ - 2 KHZ

= 98KHZ

6.7 To get the SSB (USB) signal connect balanced modulator outputs to summer and note down the frequency of SSB wave and compare this with theoretical value

SSB (USB) = RF frequency - AF Frequency

= 100KHZ + 2 KHZ

= 102KHZ.

6.8 Connect the SSB signal from summer or subs tractor to SSB signal input of synchronous detector and RF signal to the RF input of the synchronous detector.

6.9 Observe the detector output, which is replica of modulating signal (AF signal).

6.10 Repeat all the steps for different frequencies of AF signals.

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:

8.1 Amplitude of AF Gr 0^0 phase signal = ………………………. V.
8.2 Frequency of AF Gr 0^0 phase signal = ………………………. HZ.
8.3 Amplitude of AF Gr90^0 phase signal = ………………………. V.
8.4 Frequency of AF Gr90^0 phase signal = ………………………. HZ.
8.5 Amplitude of RF Gr 0^0 phase signal = ………………………. V.
8.6 Frequency of RF Gr 0^0 phase signal = ………………………. HZ.
8.7 Amplitude of RF Gr90^0 phase signal = ………………………. V.
8.8 Frequency of RF Gr90^0 phase signal = ………………………. HZ.
8.9 Amplitude of SSB (USB) signal = …………………………v.
8.10 Frequency of SSB (USB) signal = ………………………. HZ.
8.11 Amplitude of SSB (LSB) signal = …………………………v.
8.12 Frequency of SSB (LSB) signal = ………………………. HZ.

9. CONCLUSION:

The output waveforms of SSB modulation and de-modulation are observed and plotted.

10. VIVA -VOCE QUESTIONS:

10.1 What is the use of SSB modulation over DSB-SC modulation?
10.2 What is the amount of power saving in SSB over DSB-SC?
10.3 What is the bandwidth of SSB?
10.4 What is the application of SSB?
10.5 What are the advantages of SSB over conventional AM and DSB-SC?
10.6 Write the equation for SSB-SC in Time domain?
10.7 Define SSB-SC over AM.

10.8 Write the power relation equation for SSB-SC?

10.9 What are the Generation and Detection methods of SSB-SC?

10.10 Write the equation for SSB-SC in Frequency domain?

11. APPLICATIONS:

In radio communications, single-sideband modulation (SSB) or single-sideband suppressed-carrier modulation (SSB-SC) is a refinement of amplitude modulation which uses transmitter power and bandwidth more efficiently.

EXPERIMENT NO: 3
SSB-SC MODULATOR & DETECTOR (PHASE SHIFT METHOD)

AIM:

To generate SSBSC wave Modulation using MATLAB Software.

APPARATUS REQUIRED:

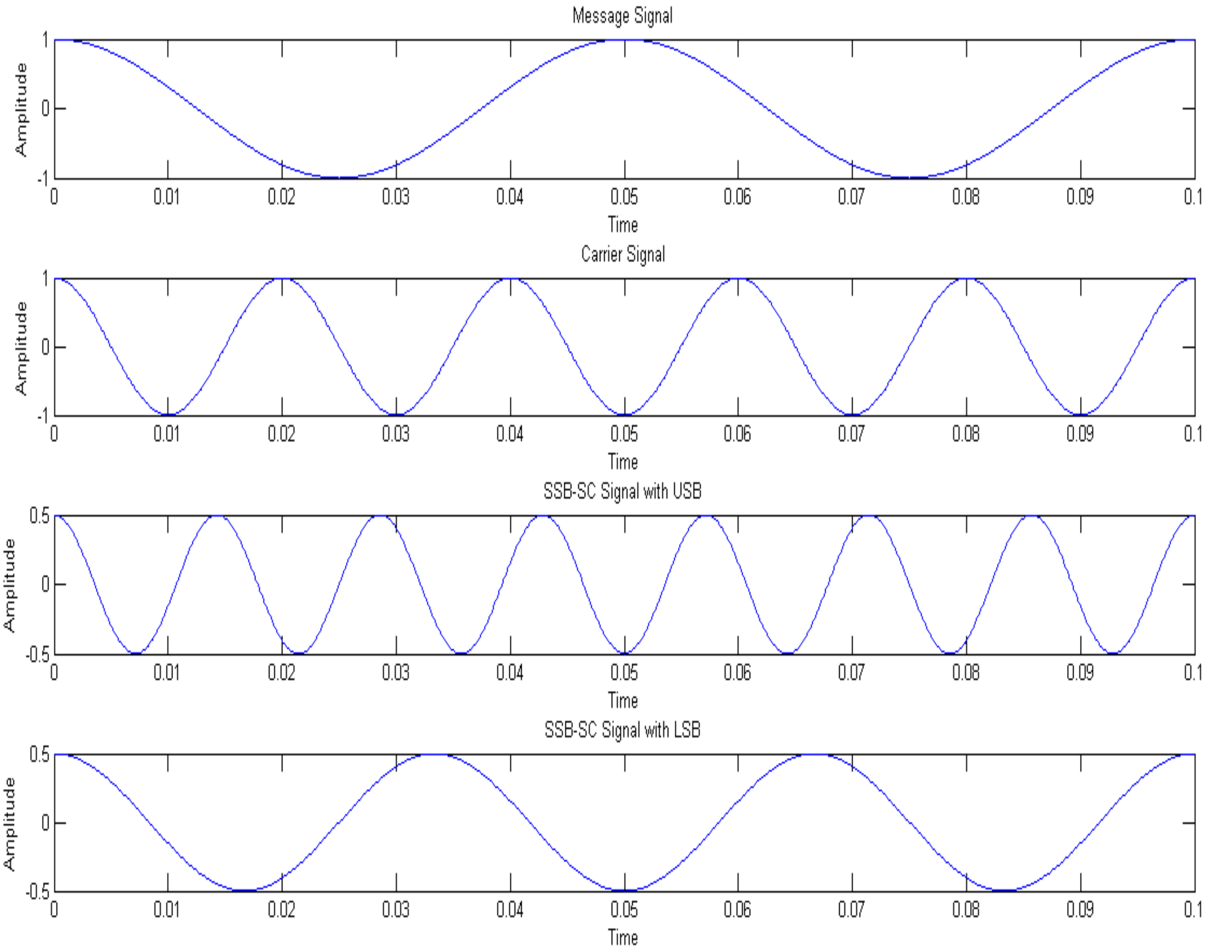
1.Computer

2. MATLAB

PROGRAM:

```
s=8000;
fm=20;
fc=50;
Am=1;
Ac=1;
t=[0:.1*fs]/fs;
subplot(4,2,1);
m1=Am*cos(2*pi*fm*t);
plot(t,m1);
title('Message Signal');
m2=Am*sin(2*pi*fm*t);
subplot(4,2,2)
c1=Ac*cos(2*pi*fc*t);
plot(t,c1)
title('Carrier Signal');
c2=Ac*sin(2*pi*fc*t);
subplot(4,2,3)
Susb=0.5*m1.*c1-0.5*m2.*c2;
plot(t,Susb);
title('SSB-SC Signal with USB');
subplot(4,2,4);
Slsb=0.5*m1.*c1+0.5*m2.*c2;
plot(t,Slsb);
title('SSB-SC Signal with LSB');
r = Susb.*c1;
[b a] = butter(1,0.0001);
mr= filter(b,a,r);
subplot(4,2,5);
plot(t,mr);
```

Simulated Wave forms



INFERENCE:
The SSBSC wave has been generated by using a MATLAB Software.

EXERCISE:

1) Generate a SSB-SC signal with LSB 450 Hz
2) Generate a SSB-SC signal with USB 550 Hz
3) Generate a SSB-SC signal with LSB 950 Hz
4) Generate a SSB-SC signal with USB 1050 Hz
5) Generate a SSB-SC signal with LSB 150 Hz
6) Generate a SSB-SC signal with USB 250 Hz.
7) Generate a SSB-SC signal with LSB 110 Hz
8) Generate a SSB-SC signal with USB 650 Hz
9) Generate a SSB-SC signal with LSB 850 Hz
10) Generate a SSB-SC signal with USB 1150 Hz
11) Generate a SSB-SC signal with LSB 650 Hz
12) Generate a SSB-SC signal with USB 750 Hz
13) Generate a SSB-SC signal with LSB 850 Hz
14) Generate a SSB-SC signal with USB 1100 Hz
15) Generate a SSB-SC signal with LSB 1200 Hz
16) Generate a SSB-SC signal with USB 400 Hz.

17) Generate a SSB-SC signal with LSB 100 Hz
18) Generate a SSB-SC signal with USB 600 Hz
19) Generate a SSB-SC signal with LSB 800 Hz
20) Generate a SSB-SC signal with USB 1350 Hz
21) Generate a SSB-SC signal with LSB 1000 Hz
22) Generate a SSB-SC signal with USB 675 Hz
23) Generate a SSB-SC signal with LSB 855Hz
24) Generate a SSB-SC signal with USB 1110 Hz
25) Generate a SSB-SC signal with LSB 710 Hz

FREQUENCY MODULATION AND DEMODULATION	EXPT. NO: 4
	DATE:

1. AIM:

1.1 To study the frequency modulation and demodulation for different modulation index.

2. COMPONENTS & TOOLS REQUIRED:

2. 1. Audio signal generator

2. 2. Carrier generator

2. 3. Frequency modulator Trainer Kit

2. 4. Cathode ray oscilloscope (30 MHz).

2.5. Connecting wires

3. THEORY:

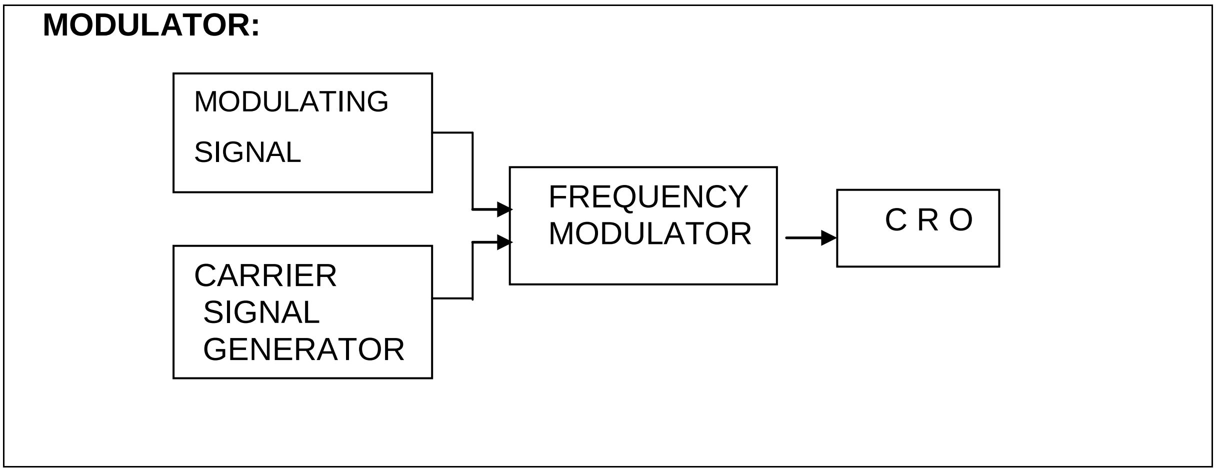
FM Modulation is a non-linear modulation technique. In FM the frequency of carrier is varied in accordance with amplitude of modulating signal (AF signal). But amplitude is maintained constant. Since the variation in phase angular term it is comes under angle modulation scheme, the most important feature 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 and we transmit the FM signals to longer distances.

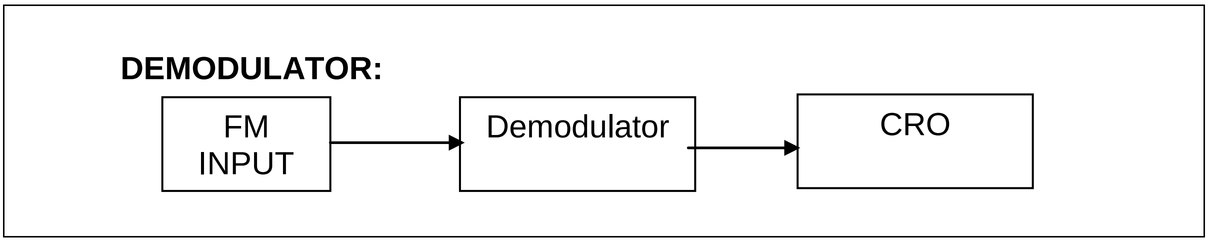
The quantity K_f represents frequency sensitivity of modulator. Hence Kf * Am represents the total deviation f. The ratio of max frequency deviation to modulating frequency defines as modulation index, which is given by

$$\text{Modulation index} = \frac{\text{Max frequency deviation}}{\text{Modulating frequency}}$$

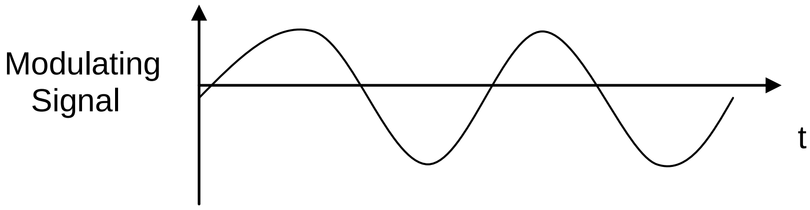
If Modulation index is less than one then the modulated wave is called Narrow Band FM signal. If Modulation index is greater than one then the modulated wave is called Wide Band FM signal.

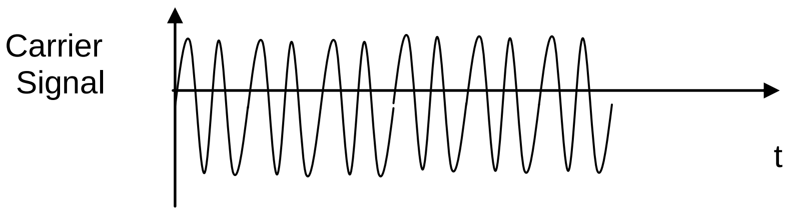
4. BLOCK DIAGRAM:

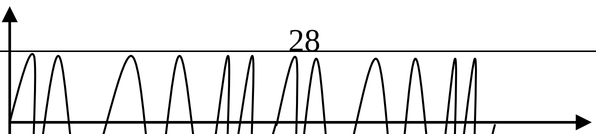




5. MODEL WAVEFORMS:







FM
Modulating
Signal

t

Demodulated
Signal

6. EXPERIMENTAL PROCEDURE:

6.1 Switch on the power supply through mains card.

6.2 Observe the modulating signal in CRO and set the modulating voltage to 1.2 V and frequency to 10 KHz and note down these values. (Here the carrier is internally generated signal).

6.3 Connect the modulating signal to modulator also connect the output of Modulator to CRO and note down the waveforms.

6.4 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 above formula.

6.5 Connect the frequency-modulated signal to the demodulator.

6.6 Connect the CRO across the output terminals of the demodulator.

6.7 Observe the waveform of the modulating signal for different modulating indices.

9. PRECAUTIONS:

7.1 Check for loose contacts of wires and components.

7.2 Keep all the control knobs in the minimum position.

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

7.4 Adjust the control knobs smoothly.

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

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

8. Observations:

8.1 Amplitude of modulating signal_____________

8.2 Frequency of modulating signal______________

8.3 Amplitude of carrier signal_________________

8.4 Frequency of carrier signal_________________

8.5 Frequency deviation _________________

8.6 Amplitude of demodulating signal___________

8.7 Frequency of demodulating signal___________

9. CONCLUSION:

The output waveforms of frequency modulation are observed for modulation index less than one and greater than one. Also demodulation is verified.

10. VIVA -VOCE QUESTIONS:

10.1 What is frequency modulation?

10.2 How the FM can be differentiated from the frequency translation?

10.3 In Frequency modulated waveform where does the message signal exist?

10.4 What is meant by carrier nulls?

10.5 What is the bandwidth required for NBFM?

10.6 What is the bandwidth required for WBFM?

10.7 Generate FM wave using PM modulator?

10.8 Generate FM wave using PM modulator?

10.9 Define Frequency Deviation. What is practical Frequency Deviation value for FM broadcasting?

10.10 Write the equation for FM and PM waves?

11. APPLICATIONS:

Frequency modulation is widely used for FM radio broadcasting. It is also used in telemetry, radar, seismic prospecting, and monitoring newborns for seizures via EEG, two-way radio systems, music synthesis, magnetic tape-recording systems and some video-transmission systems

EXPERIMENT NO: 4
FREQUENCY MODULATION & DEMODULATION

AIM:

To generate FM wave Modulation using MATLAB Software.

APPARATUS REQUIRED:

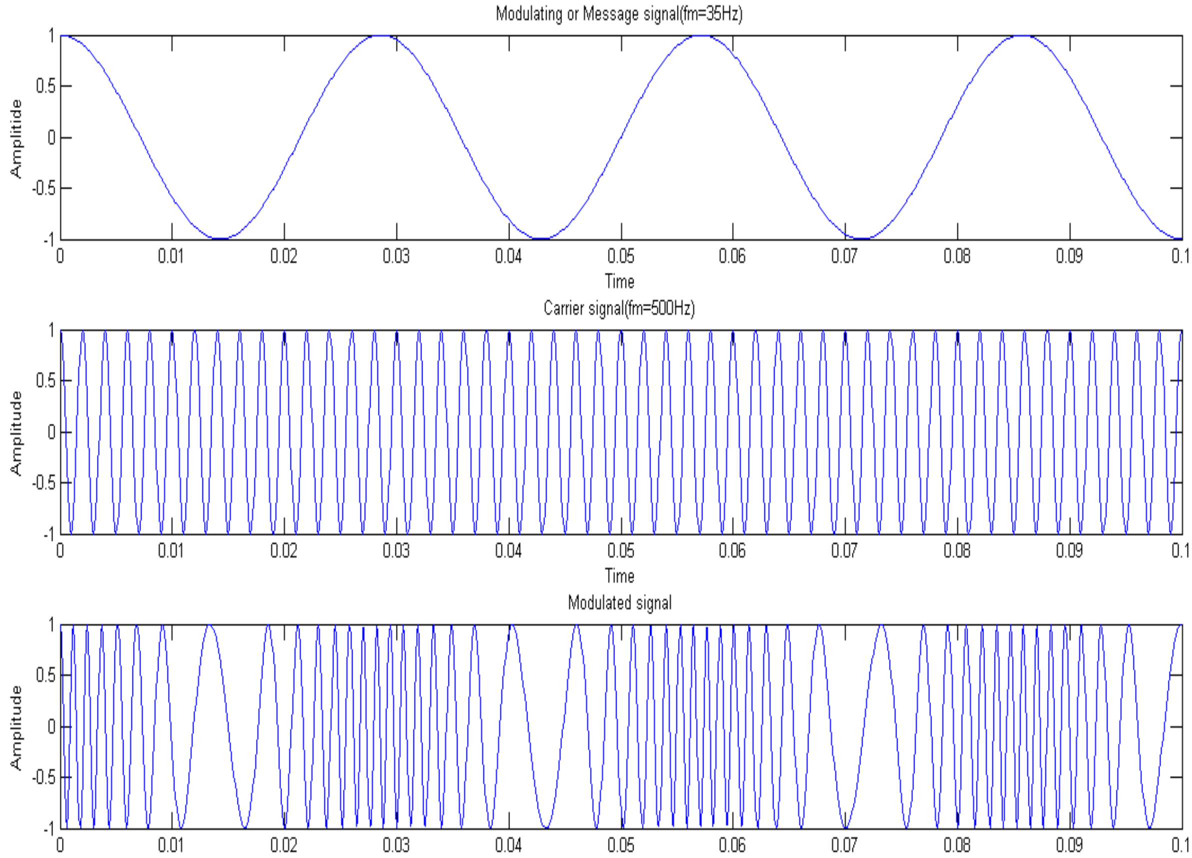
1.Computer

2. MATLAB

PROGRAM:

```
%The frequency modulation(FM)waveform in time and frequency domain.
%fm=35HZ,fc=500HZ,Am=1V,Ac=1V,B=10
functionfmdm
fs=10000;
Ac=1;
Am=1;
fm=35;
fc=500;
B=10;
t=(0:.1*fs)/fs;
wc=2*pi*fc;
wm=2*pi*fm;
m_t=Am*cos(wm*t);
subplot(5,1,1);
plot(t,m_t);
title('Modulating or Message signal(fm=35Hz)');
c_t=Ac*cos(wc*t);
subplot(5,1,2);
plot(t,c_t);
title('Carrier signal(fm=500Hz)');
s_t=Ac*cos((wc*t)+B*sin(wm*t));
subplot(5,1,3);
plot(t,s_t);
title('Modulated signal');
d=demod(s_t,fc,fs,'fm');
subplot(5,1,4);
plot(t,d);
title('demodulated signal');
```

Simulated Wave forms



INFERENCE:

The FM wave has been generated by using a MATLAB Software.

EXERCISE:

1) Generate an FM signal with Δf=20Khz
2) Generate a FM signal when message input is a square wave and carrier is a sinusoidal waveform.
3) Generate a FM signal when message input is a sinusoidal wave and carrier is a square waveform.
4) Generate an FM signal with Δf=10Khz
5) Generate an FM signal with Δf=100Khz
6) Generate an FM signal with Δf=50Khz
7) Generate an FM signal with Δf=300Khz
8) Generate an FM signal with Δf=90Khz
9) Generate an FM signal with Δf=400Khz
10) Generate an FM signal with Δf=700KhZ
11) Generate an FM signal with Δf=30Khz
12) Generate a FM signal when message input is a sinusoidal wave and carrier is a triangular waveform.
13) Generate a FM signal when message input is a triangular wave and carrier is a square waveform.
14) Generate an FM signal with Δf=40Khz
15) Generate an FM signal with Δf=200Khz
16) Generate an FM signal with Δf=150Khz
17) Generate an FM signal with Δf=250Khz

18) Generate an FM signal with Δf=90Khz
19) Generate an FM signal with Δf=420Khz
20) Generate an FM signal with Δf=70KhZ

21) Generate an FM signal with Δf=1000KhZ
22) Generate an FM signal with Δf=300Khz
23) Generate a FM signal when message input is a sinusoidal wave and carrier is a rectangular waveform.
24) Generate a FM signal when message input is a triangular wave and carrier is a sine waveform.
25) Generate an FM signal with Δf=410Khz

SPECTRUM ANALYSER USING AM SIGNAL	EXPT. NO: 5A
	DATE:

1. AIM:

1.3 To study the spectrum of AM signals using spectrum analyzer.

2. COMPONENTS & TOOLS REQUIRED:

2.1 Spectrum Analyzer.

2.2 Function generator.

2.3 AM Wave generators

3. THEORY:

3.1. INTRODUCTION TO SPECTRUM ANALYSER:

The analyzer of electrical signals is a fundamental problem for many Engineers and scientists.

The traditional ways of observing the electrical signal is in time domain by using oscilloscope. The time domain is used to recover relative timing and phase information which is used to characterize electric circuit behavior .

But practically some circuits like Amplifiers, Filters, Oscillators, Modulators, Mixers etc,. Requires frequency domain analysis. This frequency domain analysis can be easily studied in using Spectrum analyzer. It graphically displays voltage or power function of frequency on a circuit.

Basically two types of spectrum analyzer are available. They are

1. Swept – tuned
2. Real – time

The HM5010 is the swept – tuned Spectrum analyzer. This spectrum analyzer permits the detection of spectrum components of electrical signal in the frequency range of 0.15MHz to1050 MHz. In the oscilloscope the amplitude is displayed on the time domain and in spectrum analyzer it will be displayed in frequency domain.

3.2. ADVANTAGES OF SPECTRUM ANALYZER:

3.2.1 Spectrum analyzer are used to observe the difference fill characteristics.

3.2.2 It used to observe the Modulated wave from spectrum

3.2.3 It is used to observe the Noise level in the transmission
Ex: In CATV

3.3. CONTROL ELEMENTS:

3.3.1. MARKER ON / OFF:

When the marker push button is set to the off position the CF indicator is lit and display shows the center frequency. When the switch is in the ON position 1 MHz the display shows the marker frequency. The marker shows on the screen a sharp peak the marker frequency is adjustable by means of the marker knob and can be aligned with a spectral line.

NOTE: Switch off the marker before taking correct amplitude reading.

3.3.2. CF / MK: (CENTER FREQUENCY / MARKER)

The CF LED is lit when the digital display shows the center frequency. The center frequency is the frequency, which is displayed in the horizontal center of the CRT. The MK LED is lit when the marker pushbutton is in the ON position. The digital display shows the marker frequency in the case.

3.3.3. DIGITAL DISPLAY: (DISPLAY OF CENTER FREQUENCY / MARKER FREQUENCY):

SIGM: Display with 100 KHz resolution.

UNCAL: Blinking of this LED indicates incorrectly displayed amplitude values. This is to scan width and filter setting combinations which give to low amplitude readings because the IF filters have not being settled. This may occur when the scanned frequency range is too large compared to the IF bandwidth (20 KHz) and or the video filter bandwidth (4 KHz). Measurements in the case can either be taken with out a video filter or the scan width has to be decreased

CENTER FREQUENCY: COARSE / FINE:

Both rotary knobs are used for center frequency setting. The center frequency is displayed at the horizontal center of the screen.

BAND WIDTH: Selects between 400 KHz. If a bandwidth of 20 KHz is selected the noise level decreases and the selectivity is improved spectral lines which are relatively close together can be distinguished. As the small signal transient response amplitude values if the scan width is set at too wide a frequency span. The uncial LED will indicate this condition.

SCAN WIDTH: The scan width selectors control the scan width per division of the horizontal axis. The frequency / Dis can be increased by means of the > button and decreased by means of the < button. The width of the scan range is displayed in MHz / Div and refers to each horizontal division on the graticule the center frequency is indicated by the vertical line at middle of the horizontal axis. The frequency decreased to the left in a similar way. In this case the left graticule line corresponds to 0 Hz with these settings a spectral line is visible which is referred to as zero frequency. Spectral lines displayed left of the zero frequency point are so called image frequency. In the zero scan made the spectrum analyzer operates like a receiver with selectable band width. The frequency is selected via the center frequency .The selected scan width / div settings are indicated by a number of LEDs above the range setting puss buttons.

3.4 APPLICATIONS:

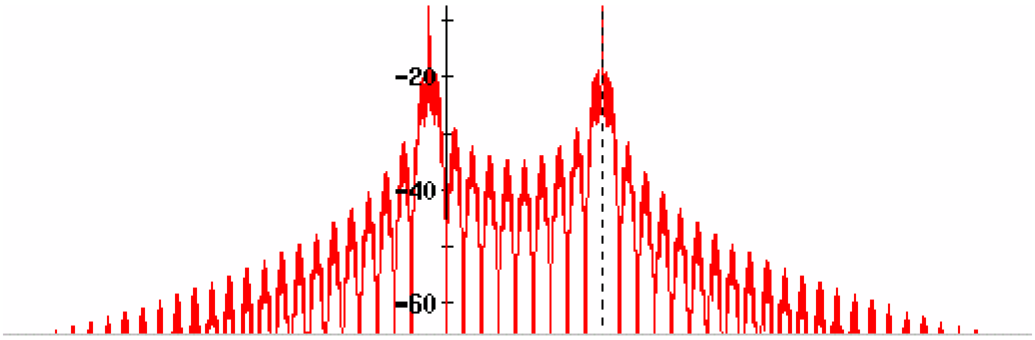
3.4.1 The spectrum analyzer is useful for observing the amplitude modulation frequency, modulation frequency spectrum.

3.4.2. It is useful in measuring low level modulation.

3.4.3. It is used in measuring carrier frequency and modulation level.

4. MODEL WAVEFORMS:

AM Spectral Analysis Signal :



5. PRECAUTIONS:

5.1 Check for loose contacts of wires and components.

5.2 Keep all the control knobs in the minimum position.

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

5.4 Adjust the control knobs smoothly.

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

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

6. CONCLUSION:

The spectrum of AM Signals are observed using spectrum analyzer and plotted.

7. VIVA -VOCE QUESTIONS:

7.1 Define a spectrum?

7.2 Is it possible to visualize the time domain signals using spectrum analyzer?

7.3 How can we select the central frequency?

7.4 How many side bands appear for a conventional AM signal?

7.5 What are the major components required to apply the AM signals to the spectrum analyzer?

7.6 Define a marker?

7.7 Is it possible to visualize the time domain signals using spectrum analyzer?

7.8 Draw the Spectrum of AM wave?

7.9 Draw the Spectrum of DSB and SSB wave?

7.10 What are frequencies components present in AM wave?

7.11 What are the major components required to apply the AM signals to the spectrum analyzer?

SPECTRUM ANALYSER USING FM SIGNAL	EXPT. NO: 5B
	DATE:

1. AIM:

1.4 To study the spectrum of FM signals using spectrum analyzer.

2. COMPONENTS & TOOLS REQUIRED:

2.1 Spectrum Analyzer.

2.2 Function generator.

2.3 AM Wave generators

3. THEORY:

3.1. INTRODUCTION TO SPECTRUM ANALYSER:

The analyzer of electrical signals is a fundamental problems for many Engineers and scientists.

The traditional ways of observing the electrical signal is in time domain by using oscilloscope. The time domain is used to recover relative timing and phase information which is used to characterize electric circuit behavior.

But practically some circuits like Amplifiers, Filters, Oscillators, Modulators, Mixers etc,. Requires frequency domain analysis. This frequency domain analysis can be easily studied in using Spectrum analyzer. It graphically displays voltage or power function of frequency on a circuit.

Basically two types of spectrum analyzer are available. They are

3. Swept – tuned
4. Real – time

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3.2. ADVANTAGES OF SPECTRUM ANALYZER:

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Ex: In CATV

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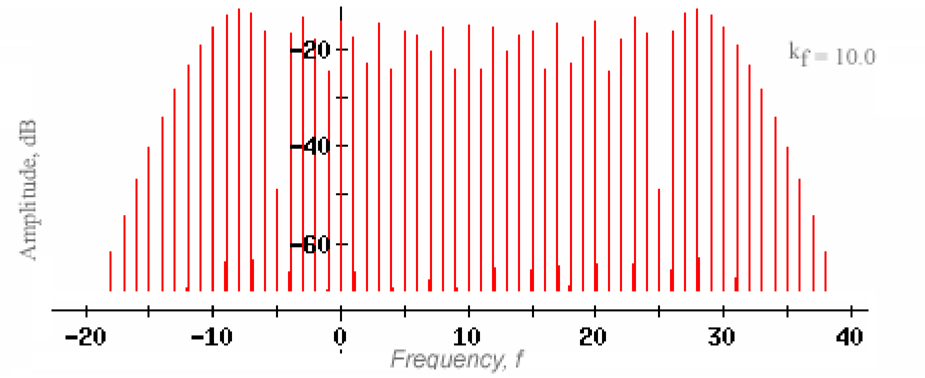
3.4.1 The spectrum analyzer is useful for observing the amplitude modulation frequency, modulation frequency spectrum.

3.4.4. It is useful in measuring low level modulation.

3.4.5. It is used in measuring carrier frequency and modulation level.

4. MODEL WAVEFORMS:

FM Spectral Analysis Signal:



5. PRECAUTIONS:

5.1 Check for loose contacts of wires and components.

5.2 Keep all the control knobs in the minimum position.

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

5.4 Adjust the control knobs smoothly.

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

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

6. CONCLUSION:

The spectrum of FM Signals is observed using spectrum analyzer and plotted.

7. VIVA -VOCE QUESTIONS:

7.1 Define a spectrum?

7.2 Is it possible to visualize the time domain signals using spectrum analyzer?

7.3 How can we select the central frequency?

7.4 How many side bands appear for a conventional FM signal?

7.5 What are the major components required to apply the FM signals to the spectrum analyzer?

7.6 Define a marker?

7.7 Draw the Spectrum of FM wave?

7.8 Draw the Spectrum of DSB and SSB wave?

7.9 What are frequencies components present in AM wave?

7.10 What are the major components required to apply the AM

PRE-EMPHASIS AND DE-EMPHASIS FILTERS	EXPT. NO : 6
	DATE :

1. AIM:

1.5 To study the characteristics of pre – emphasis and de – emphasis.

2. COMPONENTS & TOOLS REQUIRED:

2. 1. Resistors … 0.75k, 1.5k
2. 2. Capacitors... 0.1uf, 0.033uf

2. 3. Pre emphasis and de-emphasis Trainer Kit

2. 4. Cathode Ray Oscilloscope.

2.5. Connecting wires

3. THEORY:

In FM the interference (The noise) increases linearly with frequency, and the noise power in the receiver output is concentrated at higher frequency.

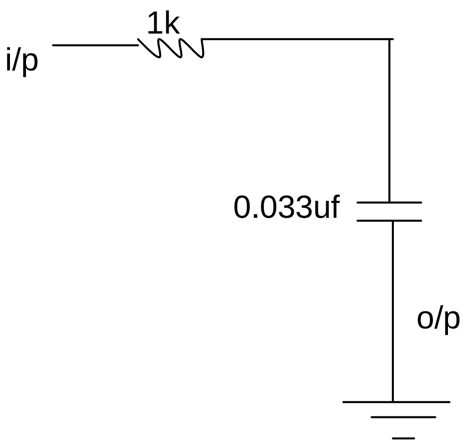
At the transmitter, weaker high frequency components of audio signal are boosted before modulation by pre-emphasis filter. At the receiver, the demodulator output passed through the De-emphasis filter, which undoes the pre-emphasis by attenuating the higher frequency components, where most of the noise is concentrated. The transfer functions of pre-emphasis and de-emphasis (PDE) are having exact opposite. Thus the process of pre-emphasis and d-emphasis leaves the desired signal untouched, but reduces the noise power considerably.

The PDE method of reduction is not limited just to FM broadcast; it is also used in audiotape recording and phonograph (analog) recording. We could also use PDE in AM broadcasting to improve the SNR, but in practice, this is not done for some reasons. That is output noise amplitude is constant with frequency, and does not vary as in FM. Hence de-emphasis does yield such a dramatic improvement in AM as it does in FM.

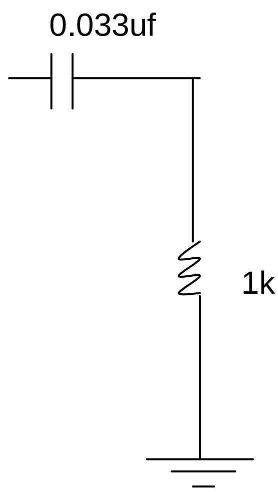
4. CIRCUIT DIAGRAM:

For T= 50 usec

Pre-emphasis



De-emphasis



For T = 75 usec :

Pre-emphasis

De-emphasis

0.01uf

7.5k

i/p

0.01uf

7.5k

o/p

5. TABULAR COLUMNS:

Pre – emphasis

For T = 50 μ sec

Freq (Hz)	I/p Voltage	o/p Voltage

For T = 75 μ sec

Freq (Hz)	I/p Voltage	o/p Voltage

De-emphasis:

For T = 50 μ sec

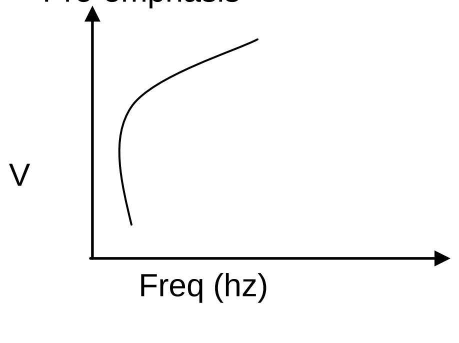
Freq (Hz)	I/p Voltage	o/p Voltage

For T = 75 μ sec

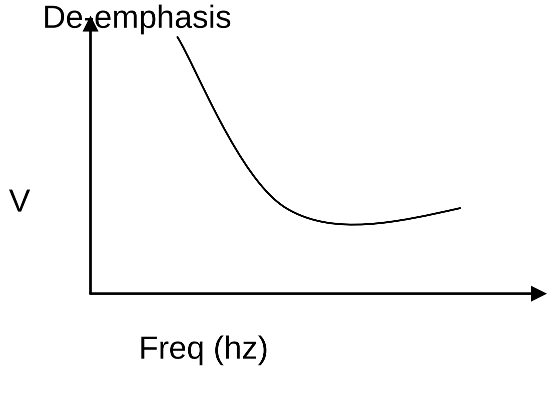
Freq (Hz)	I/p Voltage	o/p Voltage

6. MODEL WAVEFORMS:

Pre-emphasis



De-emphasis



7. EXPERIMENTAL PROCEDURE:

7.1 Switch on the power supply through mains card.

7.2 As the circuitry is already wired, you just have to trace the circuit according to the circuit diagram.

7.3 Measure output voltage of regulated power supply (+ 12 V to – 12V).

7.4 Set the output of AF generator using CRO to 10 v_{pp} and frequency range 200HZ to 20KHZ

7.5 Connect the AF signal to one of pre-emphasis network (say 75 usec)

7.6 Connect one of the channel of CRO to input of the pre-emphasis network and another channel to output of pre-emphasis network and observe the both waveform simultaneously one CRO by keeping in dual mode.

7.7 By varying AF signal frequency (amplitude must be kept constant) in steps. Note down the corresponding input and output voltage in tabular forms.

7.8 Plot the graph note the frequency (X – axis) and output voltage (Y-axis).

7.9 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 $1/2\prod RC$).

7.10 Initially set the amplitude of AF generator to minimum level and sampling frequency to 1 kHz (by adjusting the preset provided in pulse generator block). Note down the output of modulator by varying amplitude of modulating signal observe the modulator output so you that you can notice the amplitude of the sampling pulses is varying in accordance with the amplitude of the modulating signal

7.11 Repeat all the above steps for time period 50 usec.

7.12 Connect AF signal to one of De-emphasis network (say 75 usec).

7.13 Connect one of the channel of CRO to input of the De-emphasis network and another channel to output of De-emphasis network and observe the both waveforms simultaneously one CRO by keeping in dual mode.

7.14 By varying AF signal frequency (amplitude must be kept constant) in steps. Note down the corresponding input and output voltages in tabular forms.

7.15 Plot the graph between frequency (X-axis) and output voltage (Y-axis).

7.16 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 1/2∏RC).

7.17 Initially set the amplitude of AF generator to minimum level and sampling frequency to 1 kHz (by adjusting the preset provided in pulse generator block). Note down the output of modulator by varying amplitude of modulating signal observe the modulator output so you that you can notice the amplitude of the sampling pulses is varying in accordance with the amplitude of the modulating signal

7.18 Repeat all the above steps for time period 50 μ sec.

8. PRECAUTIONS:

8.1 Check for loose contacts of wires and components.

8.2 Keep all the control knobs in the minimum position.

8.3 Before switch on the power supply get the circuit connections verified by the teacher. Adjust the control knobs smoothly.

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

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

9. OBSERVATIONS:

9.1 For 75 μ sec Pre-emphasis network

R =-----------------K ohm,

C = ----------------- μ F

Theoretical value = -------------------

Practical value = ---------------------

9.2 For 50 μ sec Pre-emphasis network

R =-----------------K ohm,

C = ----------------- μ F

Theoretical value = -------------------

Practical value = ---------------------

9.3. For 75 μ sec De-emphasis network

R =-----------------K ohm,

C = ----------------- μ F

Theoretical value = -------------------

Practical value = ---------------------

9.4. For 50 μ sec De-emphasis network

R =-----------------K ohm,

C = ----------------- μ F

Theoretical value = -------------------

Practical value = ---------------------

10. CONCLUSION:

The characteristics of pre-emphasis and de-emphasis are studied and plotted.

11. VIVA -VOCE QUESTIONS:

11.1 What is pre-emphasis?

11.2 What is de-emphasis?

11.3 What is the necessity of pre-emphasis and de-emphasis circuits in FM?

11.4 Where we use the pre-emphasis and de-emphasis circuits?

11.5 What is the functionality of a pre-emphasis filter?

11.6 What is the functionality of a de-emphasis filter?

11.7 Define Threshold effect in FM?

11.8 Define Capture effect in FM?

11.9 Define CNR over SNR?

11.10 What is Figure of merit for FM?

11. APPLICATIONS:

Emphasis is commonly used in LP records and FM broadcasting. Pre-emphasis is employed in frequency modulation or phase modulation transmitters to equalize the modulating signal drive power in terms of deviation ratio. The receiver demodulation process includes a reciprocal network, called a de-emphasis network to restore the original signal power distribution

EXPERIMENT NO:6
PRE-EMPHASIS & DE-EMPHASIS

AIM:

To generate Pre-Emphasis & De-Emphasis waves by using a MATLAB Software.

APPARATUS REQUIRED:

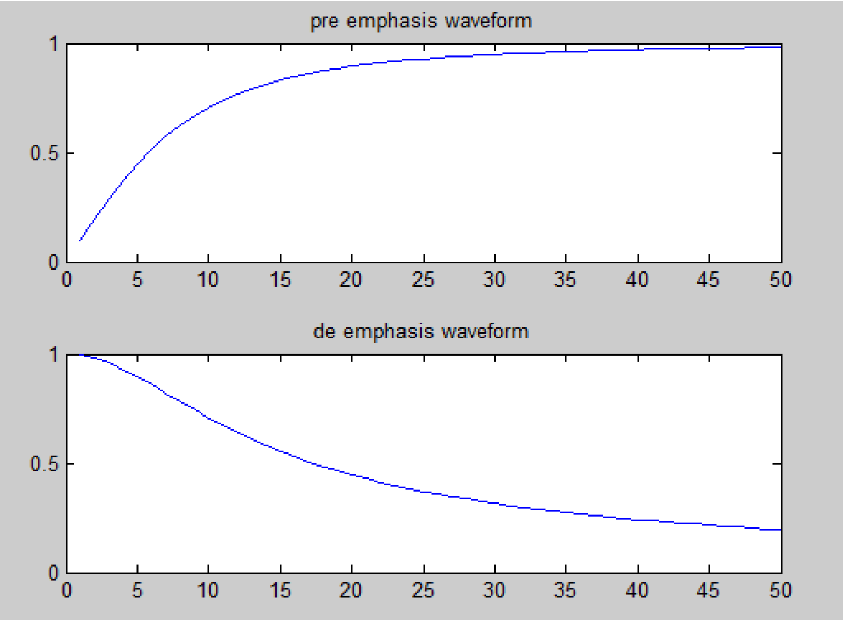
1.Computer

2. MATLAB

PROGRAM:

```
f1=10;

for f=1:50

x(f)=(1/sqrt(1+(f1/f)^2));

f2(f)=f;

end

subplot(2,1,1);

plot(f2,x);

title('pre emphasis waveform');

for f=1:50

y(f)=(1/sqrt(1+(f/f1)^2));

f3(f)=f;

end

subplot(2,1,2);

plot(f3,y);

title('de emphasis waveform');
```

Simulated Wave forms



INFERENCE:

The Pre-Emphasis and De-Emphasis waves have been generated by using a MATLAB Software.

EXERCISE:

1. Generate Pre-emphasis and De-emphasis waves for f=20.
2. Generate Pre-emphasis and De-emphasis waves for f=25.
3. Generate Pre-emphasis and De-emphasis waves for f=50.
4. Generate Pre-emphasis and De-emphasis waves for f=75
5. Generate Pre-emphasis and De-emphasis waves for f=100
6. Generate Pre-emphasis and De-emphasis waves for f=150
7. Generate Pre-emphasis and De-emphasis waves for f=175
8. Generate Pre-emphasis and De-emphasis waves for f=200
9. Generate Pre-emphasis and De-emphasis waves for f=350.
10. Generate Pre-emphasis and De-emphasis waves for f=500.
11. Generate Pre-emphasis and De-emphasis waves for f=30.
12. Generate Pre-emphasis and De-emphasis waves for f=35.
13. Generate Pre-emphasis and De-emphasis waves for f=60.
14. Generate Pre-emphasis and De-emphasis waves for f=85
15. Generate Pre-emphasis and De-emphasis waves for f=110
16. Generate Pre-emphasis and De-emphasis waves for f=160
17. Generate Pre-emphasis and De-emphasis waves for f=185
18. Generate Pre-emphasis and De-emphasis waves for f=220
19. Generate Pre-emphasis and De-emphasis waves for f=380.
20. Generate Pre-emphasis and De-emphasis waves for f=590.
21. Generate Pre-emphasis and De-emphasis waves for f=177

22. Generate Pre-emphasis and De-emphasis waves for f=210
23. Generate Pre-emphasis and De-emphasis waves for f=305.
24. Generate Pre-emphasis and De-emphasis waves for f=550.
25. Generate Pre-emphasis and De-emphasis waves for f=315.

TIME DIVISON MULTIPLEXING	EXPT. NO : 7
	DATE :

1. AIM:

1.1. To Study 4-Channel analog multiplexing and De-multiplexing techniques

1.2. To study the effect of sampling frequency variation on the out put

1.3. To study the effect of amplitude variation on the out put.

2. COMPONENTS & TOOLS REQUIRED:

2.1. TDM Trainer kit

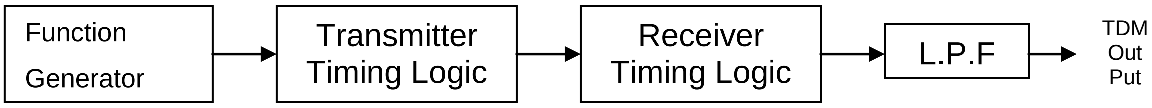
2.2.30 kHz dual channel oscilloscope

2.3. CRO probes and patch chords.

3. THEORY:

TDM is used for transmitting several analog message signals over a communication channel by dividing time frame in to number of slots. Each slot is assigned for different signal channel where each message signal must be band limited signal, N no of message signals are applied to Multiplexer through a pre-aliasing filter, then all signals are sampled sequentially. The output will be a PAM wave form containing samples of the input signals periodically interlaced in time the sample from adjacent input channel are separated by t_s/N where t_s is a sampling time and N is number of channel applied to Multiplexer. A set of N samples from each of N input samples is called Frame. The transmitter and receiver must be synchronized. The receiver distributes the all samples over n- root output channels and filter to produce the original channel information. A two level synchronization is used in TDM. Frame synchronization is necessary to establish when group of sample begin and word synchronization necessary to separate the sample with in a frame. TDM is immune to amplitude non-linearity's in channel as source of cross talk for all the different message signals are not simultaneously impressed in the channel.

4. BLOCK DIAGRAM:



5. EXPERIMENTAL PROCEDURE:

5.1. Switch on the power supply.

5.2. Set the duty cycle switch in position 5 in transmitter timing logic block.

5.3. Set the amplitudes of each modulating signal to convenient value.

5.4. Make the following connections from function block to transmitter block with 4 mm banana connectors

i. 250Hz to channel 0 (TP11)

ii. 500Hz to channel 1 (TP13)

iii. 1 kHz to channel 3 (TP15)

iv. 2 kHz to channel 4 (TP17).

5.5. Varying the amplitude of the input signals corresponding each channel by using amplitude potentiometers and observe the TDM output (TP20)

5.6. Connect output (TP20) to Rx input (TP39).

5.7. Connect TX clock to RX clock and Tx ch0 to Rx ch-0, then observe the extracted modulating (De-multiplexed signals) signals before and after low pass filters (TP 42, 44, 46, 48)

5.8. Observe by varying the duty cycle pot and see the effect on the outputs

6. PRECAUTIONS:

6.1 Check for loose contacts of wires and components.

6.2 Keep all the control knobs in the minimum position.

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

6.4 Adjust the control knobs smoothly.

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

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

7. OBSERVATION:

7.1. CH0 Modulating frequency: ----------------

7.2. CH1 Modulating frequency: ----------------

7.3. CH2 Modulating frequency: ----------------

7.4. CH3 Modulating frequency: ----------------

7.5. CH0 De-Modulating frequency: ----------------

7.6. CH1 De-Modulating frequency: ----------------

7.7. CH2 De-Modulating frequency: ----------------

7.8. CH3 De-Modulating frequency: ----------------

7.9. Time interval between any two successive samples----------------

8. CONCLUSION:

The 4-channel analog multiplexing and de-multiplexing techniques are studied and verified, the effect of sampling frequency variation and the amplitude variation on the output is observed.

9. VIVA -VOCE QUESTIONS:

9.1 What is the working principle of TDM?

9.2 What is the purpose of commutator in TDM?

9.3 In TDM how does the synchronization can be achieved?

9.4 What are the applications of TDM?

9.5 What is aperture effect?

9.6 What is the working principle of TDM?

9.7 What is the purpose of commutator in TDM?

9.8 In TDM how does the synchronization can be achieved?

9.9 What are the applications of TDM?

9.10 What is aperture effect?

10. APPLICATIONS:

Time-division multiplexing is used primarily for digital signals, but may be applied in analog multiplexing in which two or more signals or bit streams are transferred appearing simultaneously as sub-channels in one communication channel, but are physically taking turns on the channel

EXPERIMENT NO: 7
TIME DIVISION MULTIPLEXING

AIM:

To perform TDM by using MATLAB Software.

APPARATUS REQUIRED:

1.Computer

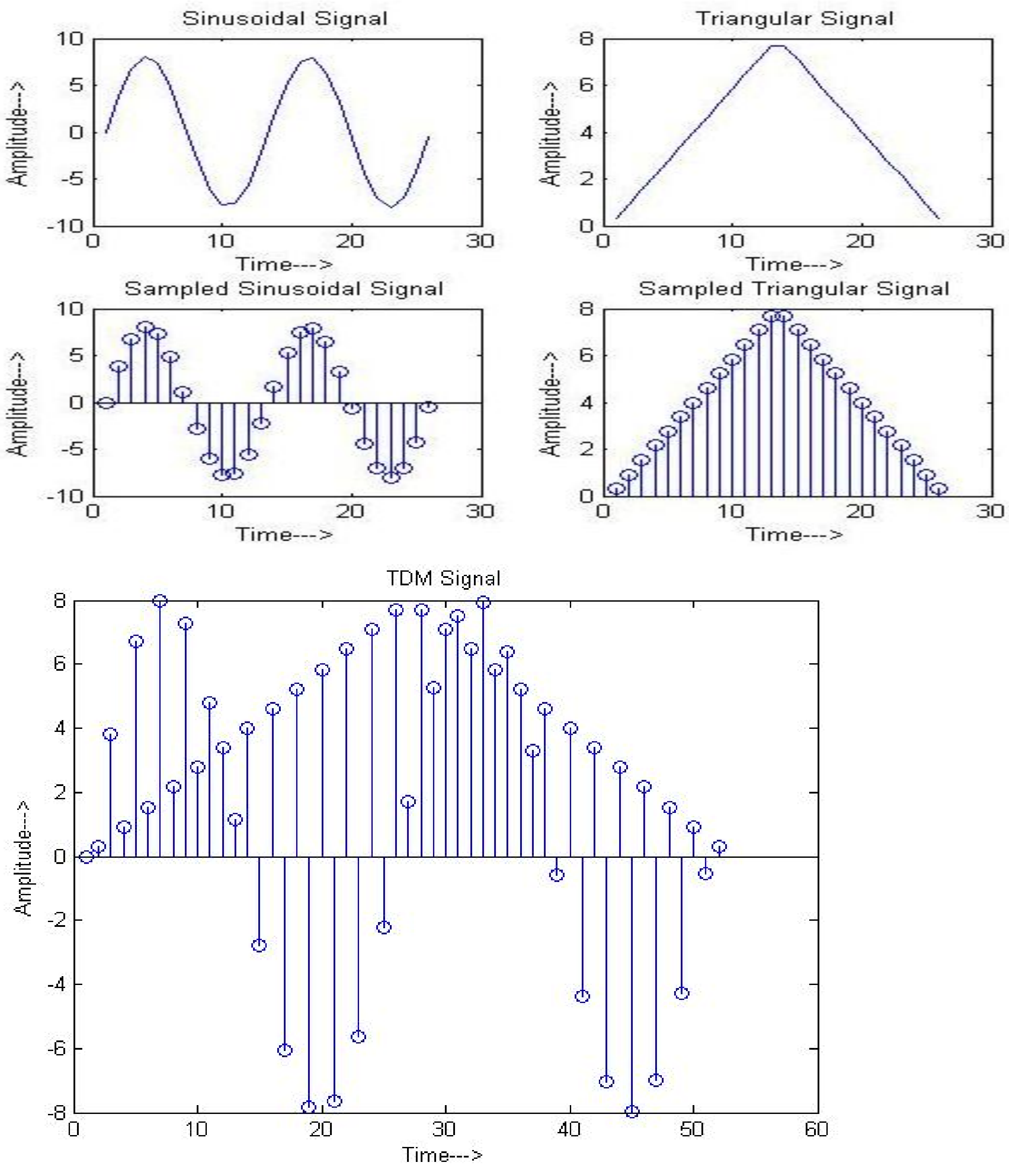
2. MATLAB

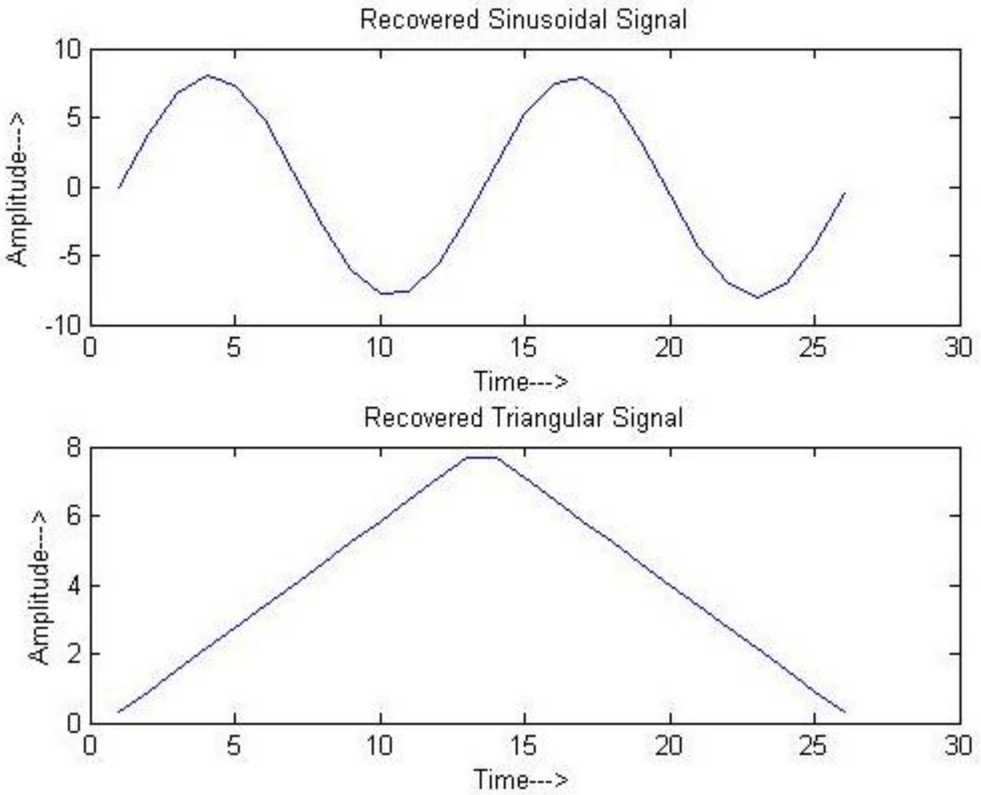
PROGRAM:

```
clc;
close all;
clear all;
% Signal generation
x=0:.5:4*pi;                    % signal taken up to 4pi
sig1=8*sin(x);                  % generate 1st sinusoidal signal
l=length(sig1);
sig2=8*triang(l);               % Generate 2nd triangular Signal

% Display of Both Signal
subplot(2,2,1);
plot(sig1);
title('Sinusoidal Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
subplot(2,2,2);
plot(sig2);
title('Triangular Signal');
ylabel('Amplitude--->');
xlabel('Time--->');

% Display of Both Sampled Signal
subplot(2,2,3);
stem(sig1);
title('Sampled Sinusoidal Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
subplot(2,2,4);
stem(sig2);
title('Sampled Triangular Signal');
ylabel('Amplitude--->');
```

```
xlabel('Time--->');
l1=length(sig1);
l2=length(sig2);
for i=1:l1
sig(1,i)=sig1(i);                    % Making Both row vector to a matrix
sig(2,i)=sig2(i);
end

% TDM of both quantize signal
tdmsig=reshape(sig,1,2*l1);
% Display of TDM Signal
figure
stem(tdmsig);
title('TDM Signal');
ylabel('Amplitude--->');
xlabel('Time--->');

% Demultiplexing of TDM Signal
demux=reshape(tdmsig,2,l1);
for i=1:l1
sig3(i)=demux(1,i);                  % Converting The matrix into row vectors
sig4(i)=demux(2,i);
end
 % display of demultiplexed signal
figure
subplot(2,1,1)
plot(sig3);
title('Recovered Sinusoidal Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
subplot(2,1,2)
plot(sig4);
title('Recovered Triangular Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
```

Simulated Wave forms





INFERENCE:

The time division Multiplexing has been performed by using a MATLAB software.

EXERCISE:

1) Perform time division multiplexing for Sine and Square wave.
2) Perform time division multiplexing for triangular and Square wave.
3) Perform time division multiplexing for Sine and Saw tooth wave.
4) Perform time division multiplexing for Saw tooth wave and square wave.
5) Perform time division multiplexing for exponential decaying wave and Sine wave.
6) Perform time division multiplexing for Sine and triangular
7) Perform time division multiplexing for triangular and saw tooth
8) Perform time division multiplexing for Sine and pulse.
9) Perform time division multiplexing for Saw tooth wave and pulse.
10) Perform time division multiplexing for exponential increasing wave and Sine wave.
11) Perform time division multiplexing for Sine wave, Square wave and triangular wave.
12) Perform time division multiplexing for triangular wave, Square wave and exponential wave.
13) Perform time division multiplexing for three different Sine waves with different frequencies.
14) Perform time division multiplexing for two different square waves.
15) Perform time division multiplexing for exponential decaying wave and exponential increasing wave.
16) Perform time division multiplexing for Square and triangular

17) Perform time division multiplexing for triangular and sine
18) Perform time division multiplexing for cosine and pulse.
19) Perform time division multiplexing for Sawtooth wave and Square.
20) Perform time division multiplexing for exponential decreasing wave and Sine wave.
21) Perform time division multiplexing for cosine wave, Square wave and triangular wave.
22) Perform time division multiplexing for triangular wave, Sawtooth wave and exponential wave.
23) Perform time division multiplexing for three different cosine waves with different frequencies.
24) Perform time division multiplexing for two different square waves.
25) Perform time division multiplexing for exponential decaying wave and exponential decreasing wave.

Frequency division multiplexing and demultiplexing	EXPT. NO : 8
	DATE :

AIM: To study the frequency division Multiplexing and De multiplexing Techniques.

APPARATUS/SOFTWARE REQUIRED:

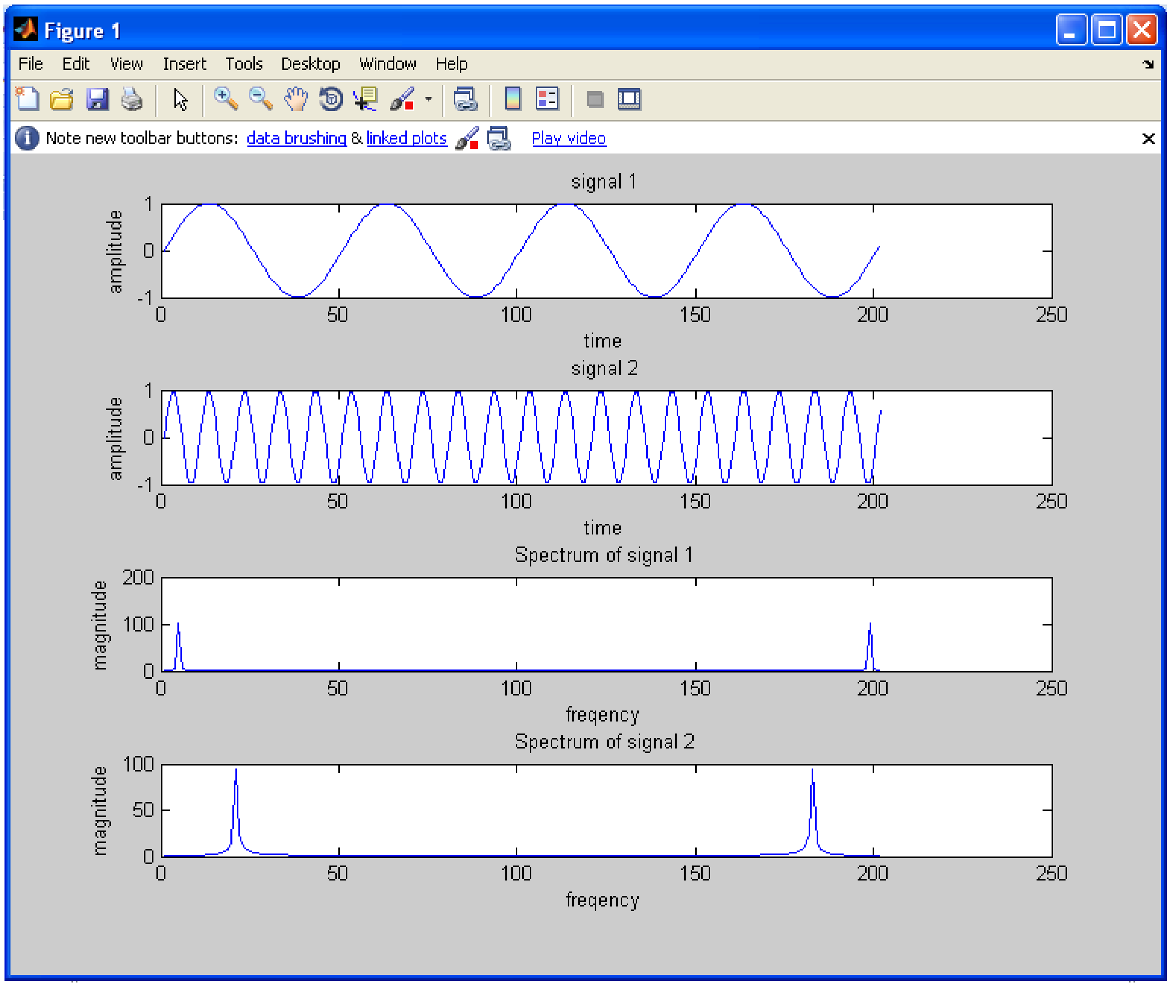
1. Pc with windows (95/98/XP/NT/2000)

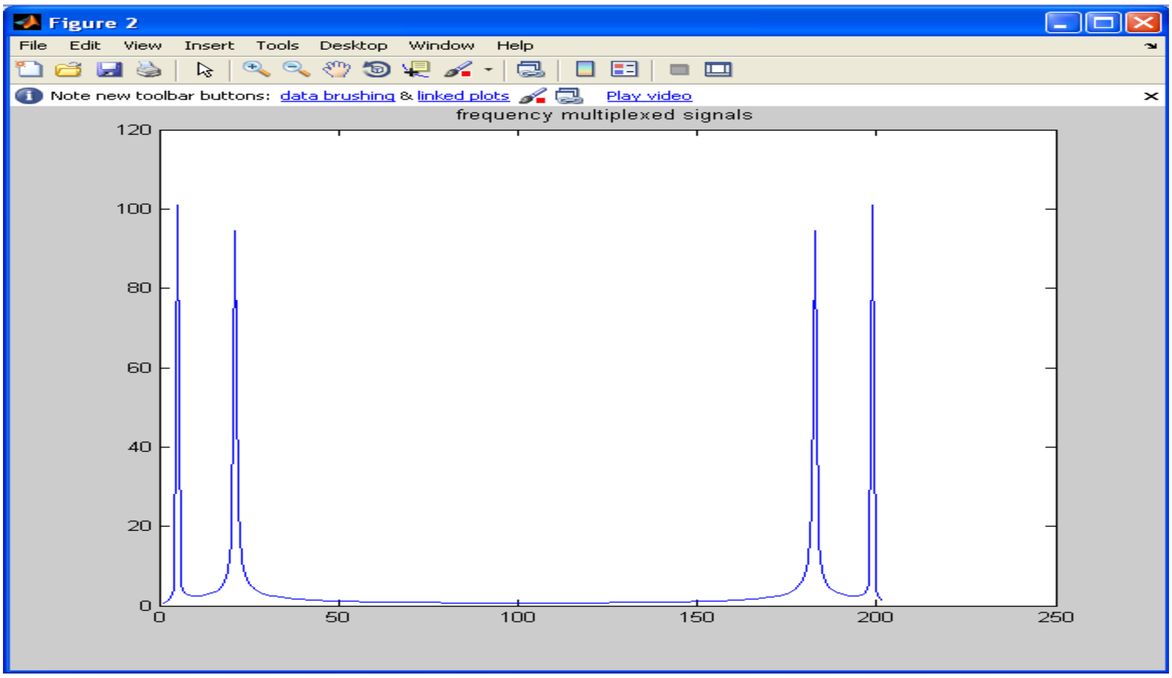
2. MATLAB Software

PROGRAM:

```
%program for frequency division multiplexing and demultiplexing
close all
clear all
clc
Fs = 100; % sampling freq
t = [0:2*Fs+1]'/Fs;
x1 = sin(2*pi*2*t); % signal 1 signal
z1 = fft(x1);
z1=abs(z1);
x2 = sin(2*pi*10*t); % signal 2 signal
z2 = fft(x2);
z2=abs(z2);
figure;
subplot(4,1,1); plot(x1);
title('signal 1');xlabel('time');ylabel('amplitude');
subplot(4,1,2); plot(x2);
title('signal 2');xlabel('time');ylabel('amplitude');
subplot(4,1,3); plot(z1);
title('Spectrum of signal 1');xlabel('freqency');ylabel('magnitude');
subplot(4,1,4); plot(z2);
title('Spectrum of signal 2');xlabel('freqency');ylabel('magnitude');
% freqency multiplexing

z=z1+z2;
figure;
plot(z);
title('frequency multiplexed signals');
figure;
% freqency demultiplexing
f1=[ones(10,1); zeros(182,1);ones(10,1)];%applying filter for signal 1
dz1=z.*f1;
d1 = ifft(dz1);
subplot(2,1,1)
plot(t*100,d1);
f2=[zeros(10,1); ones(182,1);zeros(10,1)];% applying filter for signal 2
dz2=z.*f2;
d2 = ifft(dz2);
title('recovered signal 1');xlabel('time');ylabel('amplitude');
subplot(2,1,2)
plot(t*100,d2);
title('recovered signal 2');xlabel('time');ylabel('amplitude');
```

EXPECTED WAVEFORMS:





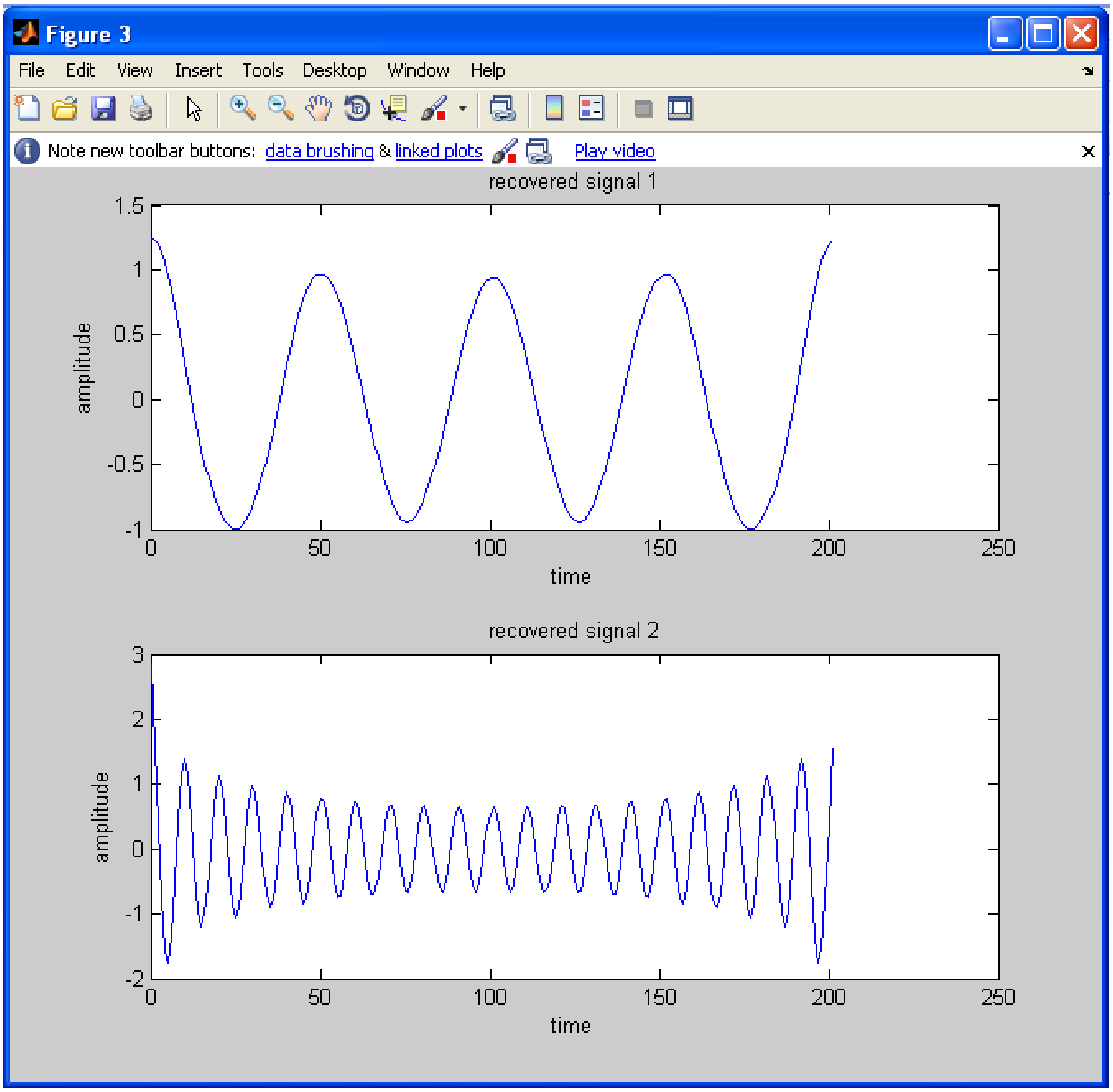


Figure 3
File Edit View Insert Tools Desktop Window Help
Note new toolbar buttons: data brushing & linked plots Play video
recovered signal 1
amplitude
time
recovered signal 2
amplitude
time

PULSE AMPLITUDE MODULATION AND DEMODULATION	EXPT. NO : 9
	DATE :

1. AIM:

1.1 To Study the process of pulse amplitude modulation and demodulation.

1.2 To study the effect of amplitude variations on the PAM output.

2. COMPONENTS & TOOLS REQUIRED:

2.1 PAM Trainer kit

2.2. 30 kHz dual channel oscilloscope

2.3. CRO probes and patch chords.

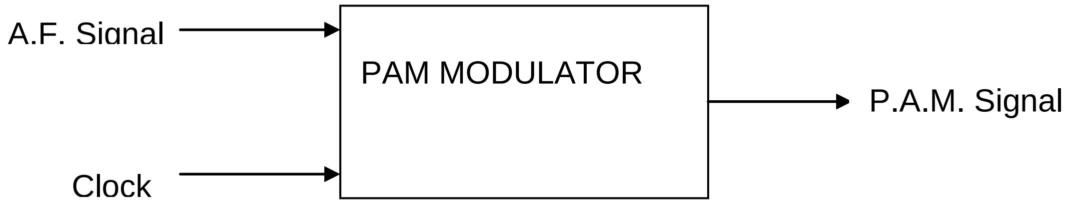
3. THEORY:

PAM is having fixed width of each pulse, but the amplitude of each pulse is made proportional to the amplitude of the modulating signal at that instant, sampling clock is applied to the base of the transistor modulating signal is applied at the collector of the transistor. So that the output of the transistor (collector current) varies according to the Modulating signal voltage. Sampling clock given at the base of the transistor will appear at the collector (same frequency of clock) but its amplitude is proportional to the modulating voltage.

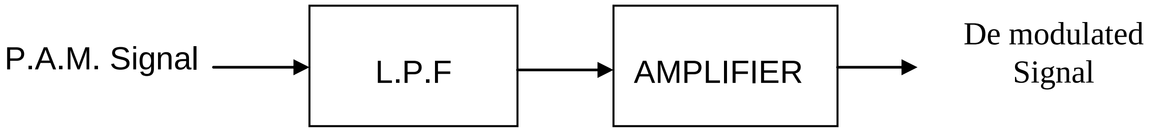
The demodulation of the PAM is quite a simple process. PAM is fed to the integrating Rx circuit (LPF), from which the demodulating signal emerges whose amplitude at any instant is proportional to the PAM at that instant. This signal is given to an inverting amplifier to amplify Its level so that demodulated output is having almost equal amplitude with the modulating signal, but it is having same phase difference.

4. BLOCK DIAGRAM:

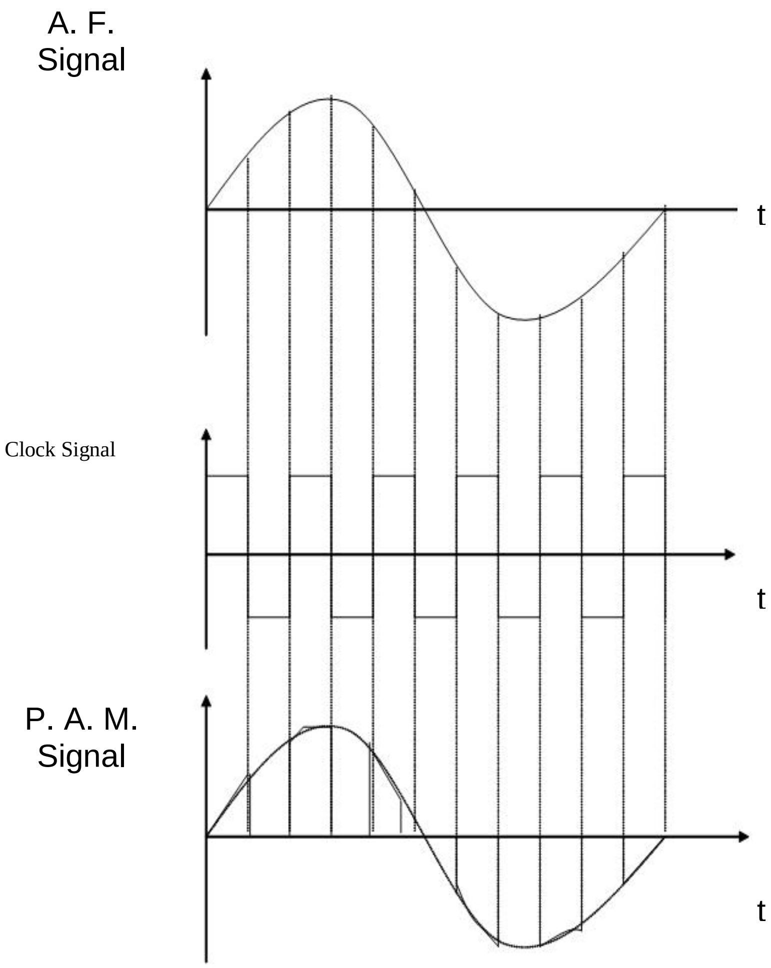
MODULATOR



DEMODULATOR



5. MODEL WAVEFORMS:



6. EXPERIMENTAL PROCEDURE:

6.1. Switch on the trainer kit.

6.2. Observe the modulating signal and carrier clock generator outputs

6.3. Adjust the modulating signal generator output to convenient value

6.4. Apply the modulating signal generator output and clock generators output to the PAM modulator.

6.5. Observe the PAM out put waveforms by varying the amplitudes of the modulating signal and modulation depths.

6.6. During demodulation connect PAM output to the input of the PAM demodulator and observe the output of PAM demodulator.

7. PRECAUTIONS:

7.1 Check for loose contacts of wires and components.

7.2 Keep all the control knobs in the minimum position.

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

7.4 Adjust the control knobs smoothly.

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

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

8. Observations:

8.1. Amplitude of the modulating signal_______________

8.2. Frequency of the modulating signal_________________

8.3. Amplitude of the De-modulating signal______________

8.4. Frequency of the De-modulating signal_______________

8.5. Sampling frequency____________________

9. CONCLUSION:

The pulse amplitude modulation and demodulation is studied, verified and the output waveforms are plotted.

10. VIVA -VOCE QUESTIONS:

10.1 What is sampling?

10.2 What is sampling theorem?

10.3 What are the various types of Pulse modulation techniques?

10.4 Define PAM?

10.5 What is the use of pulse shaping network?

10.6 What is the purpose of sample and hold circuit?

10.7 What is Bandwidth required for PAM signal?

10.8 What is Nyquist Criteria?

10.9 Draw the block diagram for the detection of PAM signal.

10.10 What are the advantages and drawbacks of PAM.

11. APPLICATIONS:

Some versions of the Ethernet communication standard are an example of PAM usage. The concept is also used for the study of photosynthesis using a specialized instrument that involves a spectrofluorometric measurement of the kinetics of fluorescence rise and decay in the light-harvesting antenna of thylakoid membranes, thus querying various aspects of the state of the photosystems under different environmental conditions.

EXPERIMENT NO: 9
PULSE AMPLITUDE MODULATION (PAM) & DEMODULATION

AIM:

To generate and detect PAM wave by using a MATLAB software.

APPARATUS REQUIRED:

1.Computer

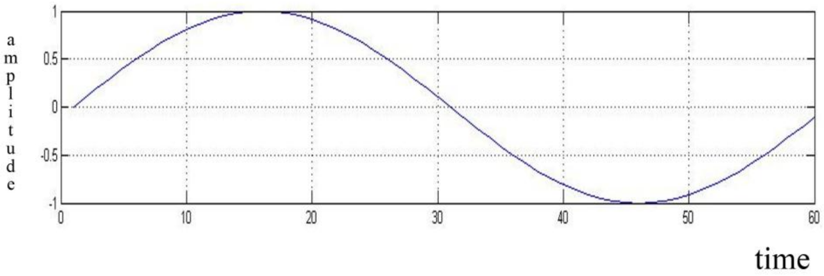
2. MATLAB

PROGRAM:

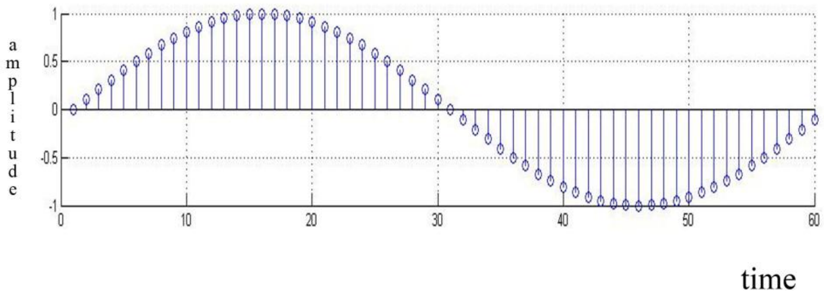
```
clc;
clf;
close all
clear all
t=0:1/6000:((10/1000)-(1/6000));
xa=sin(2*pi*100*abs(t));
Ts=32;
x=sin(2*pi*600*(Ts*t));
X=fft(xa,abs(x));
subplot(3,1,1)
plot(xa);
grid
subplot(3,1,2);
stem(X);
grid
Y=ifft(xa,X);
subplot(3,1,3)
plot(Y)
grid
```

Simulated Wave forms:

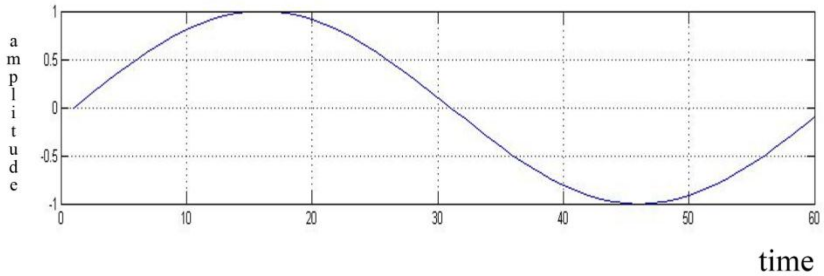
Modulating Signal



Modulated Signal



Demodulated signal



INFERENCE:
The PAM wave has been generated and detected by using a MATLAB software.

EXERCISE:

1) Generate a PAM wave with message frequency 200hz and carrier frequency 2000Hz.
2) Detect a PAM wave with message frequency 200hz and carrier frequency 2000Hz.
3) Generate a PAM wave with message frequency 50hz and carrier frequency 1000Hz.

4) Detect a PAM wave with message frequency 50hz and carrier frequency 1000Hz.
5) Generate a PAM wave with message frequency 500hz and carrier frequency 10000Hz.
6) Detect a PAM wave with message frequency 500hz and carrier frequency 10000Hz.
7) Generate a PAM wave with message frequency 300hz and carrier frequency 2000Hz.
8) Detect a PAM wave with message frequency 300hz and carrier frequency 2000Hz.
9) Generate a PAM wave with message frequency 300hz and carrier frequency 5000Hz.
10) Generate a PAM wave with message frequency 300hz and carrier frequency 5000Hz.
11) Generate a PAM wave with message frequency 250hz and carrier frequency 2500Hz.
12) Detect a PAM wave with message frequency 250hz and carrier frequency 2500Hz.
13) Generate a PAM wave with message frequency 150hz and carrier frequency 1500Hz.
14) Detect a PAM wave with message frequency 150hz and carrier frequency 1500Hz.
15) Generate a PAM wave with message frequency 550hz and carrier frequency 10500Hz.
16) Detect a PAM wave with message frequency 550hz and carrier frequency 10500Hz.
17) Generate a PAM wave with message frequency 350hz and carrier frequency 2500Hz.
18) Detect a PAM wave with message frequency 350hz and carrier frequency 2500Hz.
19) Generate a PAM wave with message frequency 380hz and carrier frequency 6000Hz.
20) Generate a PAM wave with message frequency 380hz and carrier frequency 6000Hz.
21) Detect a PAM wave with message frequency 100hz and carrier frequency 50000Hz.
22) Generate a PAM wave with message frequency 200hz and carrier frequency 1000Hz.
23) Detect a PAM wave with message frequency 150hz and carrier frequency 2000Hz.
24) Generate a PAM wave with message frequency 500hz and carrier frequency 2500Hz.
25) Generate a PAM wave with message frequency 200hz and carrier frequency 3000Hz.

PULSE WIDTH MODULATION AND DEMODULATION	EXPT. NO : 10
	DATE :

1. AIM:

1.1. To Study the process of pulse width modulation and demodulation.

1.2. To study the effect of variations in amplitude and pulse width of Pulse train on the PWM output.

2. COMPONENTS & TOOLS REQUIRED:

2.1 PWM Trainer kit

2.2. 30 kHz dual channel oscilloscope

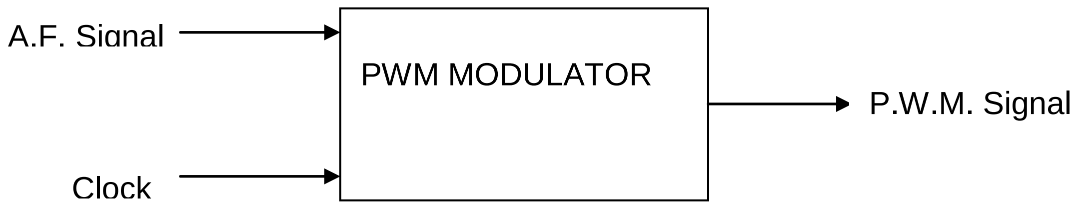
2.3. CRO probes and patch chords.

3. THEORY:

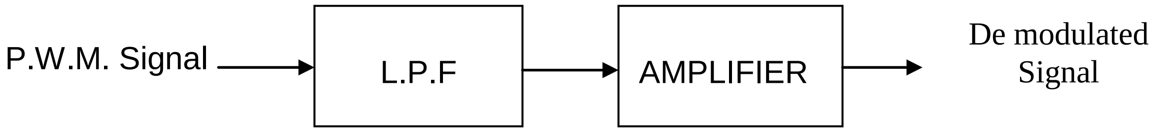
PWM is also called as pulse duration modulation or pulse length modulation. In PWM, the width of the pulse is varied in proportional to the amplitude of the analog input signal. Three types of PWM signals are available. Leading edge, trail edge and central edge. In leading edge PWM, the leading edge is fixed and trail edge is modulated where as in trailing edge PWM, the trailing edge is fixed and leading edge is modulated. In PWM with centered, the middle of the pulse is fixed and both edges are modulated according to the amplitude of modulating signal. PWM has disadvantage that it is varying the pulse with width and therefore varying power is not constant. So the transmitter and receiver must be able to handle maximum pulse width, but PWM works even though synchronization is not exist between the Tx and Rx pulse trails, where PPM does not. Applying trigger pulses at sampling rate to control the starting time of the pulse can generate PWM and end of the pulse depends on the amplitude of the modulating signals. The pulse width will be maximum at positive peak and minimum width at negative peak.

4. BLOCK DIAGRAM:

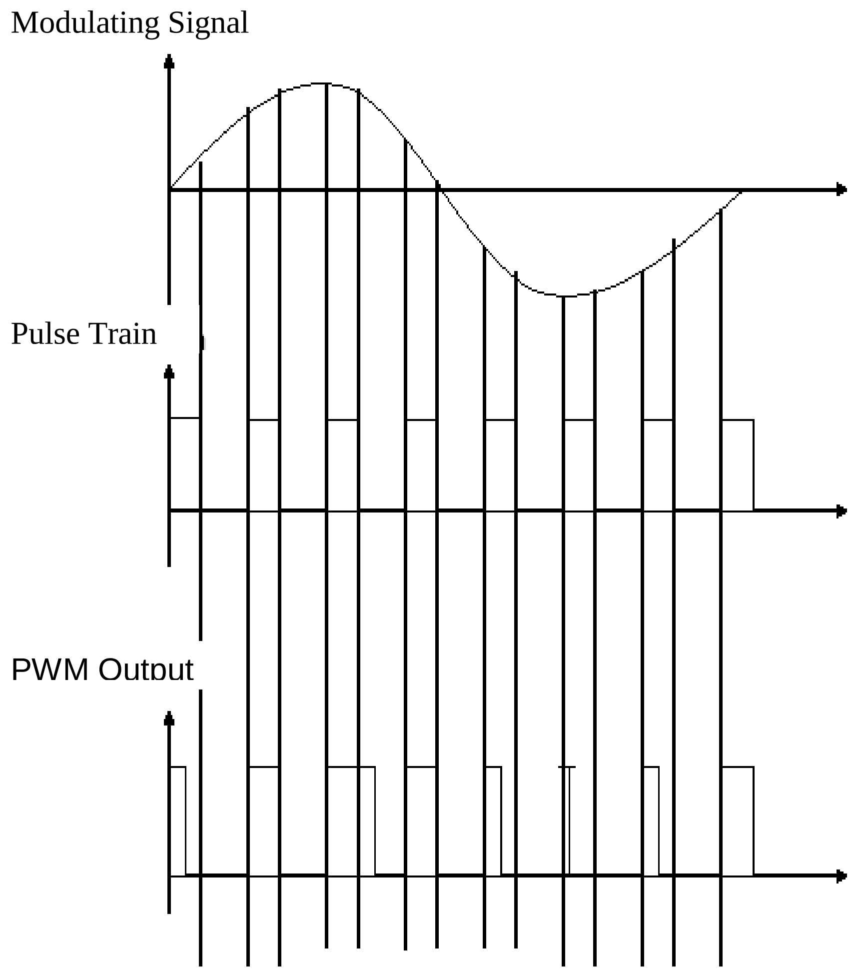
MODULATOR



DEMODULATOR



5. MODEL WAVEFORMS:



6. EXPERIMENTAL PROCEDURE:

6.1. Switch on the trainer kit.

7.2. AF signal is connected to the PWM modulator from AF generator block using a Patch chord

7.3. Observe width of the pulses in PWM output by varying amplitude of AF signal (Modulating signal).

7.4. Observe position of the pulses in PPM output by varying amplitude of AF signal (Modulating signal).

7.5. PWM is applied as an input to PWM demodulator circuit which includes higher order low pass filter and AC amplifier.

7.6. Observe the output of AC amplifier (at PWM de-modulator) which is a true replica of modulating signal (AF signal).

8. PRECAUTIONS:

7.1 Check for loose contacts of wires and components.

7.2 Keep all the control knobs in the minimum position.

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

7.4 Adjust the control knobs smoothly.

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

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

8. OBSERVATIONS:

8.1. Amplitude of the modulating signal_______________

8.2. Frequency of the modulating signal_________________

8.3. Amplitude of the De-modulating signal______________

8.4. Frequency of the De-modulating signal_______________

8.5. Sampling frequency___________________

9. CONCLUSION:

The pulse width modulation and demodulation is studied, verified and the out put waveforms are plotted.

10. VIVA -VOCE QUESTIONS:

10.1 What is the other name of pulse width modulation?

10.2 What is duty cycle?

10.3 Define PWM?

10.4 Which device is used to generate PWM waveform?

10.5 What is the necessity of saw tooth generator?

10.6 Why PAM signal is effected by noise compared to PWM?

10.7 What is Bandwidth required for PWM signal?

10.8 What is PWM signal?

10.9 Draw the block diagram for the detection of PWM signal.

10.10 What are the advantages and drawbacks of PWM.

11. APPLICATIONS:

This modulation technique used to encode 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,[1]the other being maximum power point tracking.

EXPERIMENT NO: 10
PULSE WIDTH MODULATION AND DEMODULATION

AIM:

To generate and detect PWM wave by using MATLAB software.

APPARATUS REQUIRED:

1.Computer

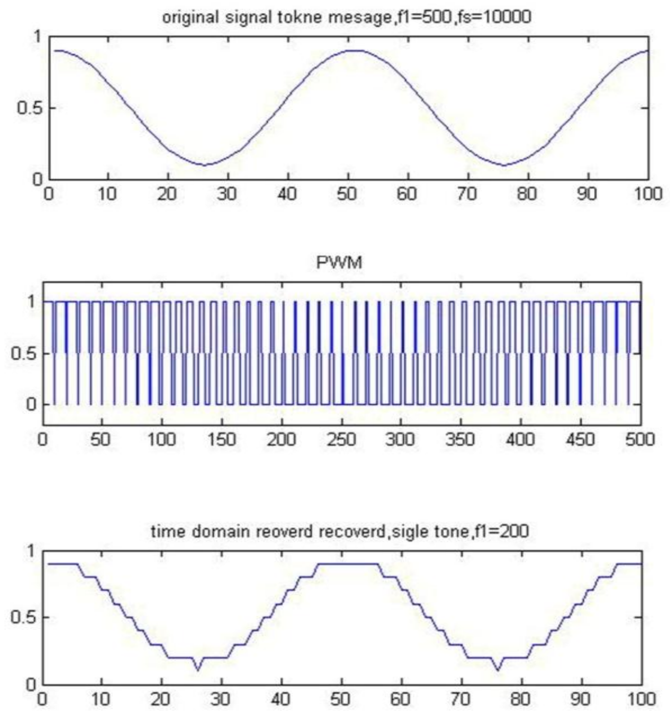
2. MATLAB

PROGRAM:

```
fc=1000;
fs=10000;
f1=200;
```

```
t=0:1/fs:((2/f1)-(1/fs));
x1=0.4*cos(2*pi*f1*t)+0.5;
%modulation
y1=modulate(x1,fc,fs,'pwm');
subplot(421);
plot(x1);
title('original signal tokne mesage,f1=500,fs=10000')
subplot(422);
plot(y1);
axis([0 500 -0.2 1.2]);
title('PWM')
%demodulation
x1_recov=demod(y1,fc,fs,'pwm');
subplot(423);
plot(x1_recov);
title('time domain reoverdrecoverd,sigle tone,f1=200');
```

Simulated Wave forms:



INFERENCE:
The PWM wave has been generated and detected by using a MATLAB software.

EXERCISE:

1) Generate a PWM wave with message frequency 200hz and carrier frequency 2000Hz.
2) Detect a PWM wave with message frequency 200hz and carrier frequency 2000Hz.
3) Generate a PWM wave with message frequency 50hz and carrier frequency 1000Hz.
4) Detect a PWM wave with message frequency 50hz and carrier frequency 1000Hz.
5) Generate a PWM wave with message frequency 500hz and carrier frequency 10000Hz.
6) Detect a PWM wave with message frequency 500hz and carrier frequency 10000Hz.
7) Generate a PWM wave with message frequency 300hz and carrier frequency 2000Hz.
8) Detect a PWM wave with message frequency 300hz and carrier frequency 2000Hz.
9) Generate a PWM wave with message frequency 300hz and carrier frequency 5000Hz.
10) Generate a PWM wave with message frequency 300hz and carrier frequency 5000Hz.
11) Generate a PWM wave with message frequency 250hz and carrier frequency 2500Hz.

12) Detect a PWM wave with message frequency 250hz and carrier frequency 2500Hz.
13) Generate a PWM wave with message frequency 150hz and carrier frequency 1500Hz.
14) Detect a PWM wave with message frequency 150hz and carrier frequency 1500Hz.
15) Generate a PWM wave with message frequency 550hz and carrier frequency 15000Hz.
16) Detect a PWM wave with message frequency 550hz and carrier frequency 15000Hz.
17) Generate a PWM wave with message frequency 350hz and carrier frequency 2500Hz.
18) Detect a PWM wave with message frequency 350hz and carrier frequency 2500Hz.
19) Generate a PWM wave with message frequency 380hz and carrier frequency 5000Hz.
20) Generate a PWM wave with message frequency 380hz and carrier frequency 5000Hz.
21) Detect a PWM wave with message frequency 150hz and carrier frequency 1500Hz.
22) Generate a PWM wave with message frequency 250hz and carrier frequency 2500Hz.
23) Detect a PWM wave with message frequency 350hz and carrier frequency 2500Hz.
24) Generate a PWM wave with message frequency 150hz and carrier frequency 1500Hz.
25) Detect a PWM wave with message frequency 750hz and carrier frequency 35000Hz.

PULSE POSITION MODULATION AND DEMODULATION	EXPT. NO : 11
	DATE :

1. AIM:

1.1. To Study the process of pulse position modulation and demodulation.
1.2. To study the effect of amplitude and frequency variations on the PPM output,

2. COMPONENTS & TOOLS REQUIRED:

2.1 PPM Trainer kit

2.2. 30 kHz dual channel oscilloscope

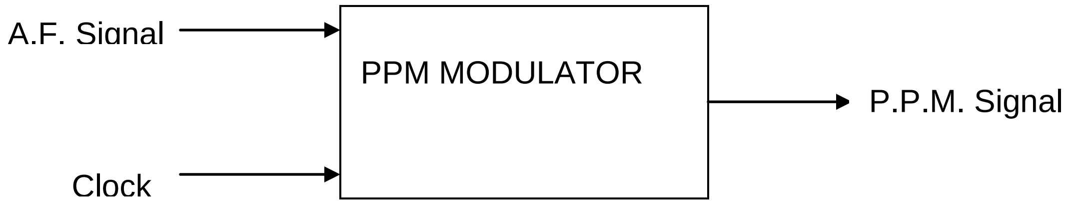
2.3. CRO probes and patch chords.

3. THEORY:

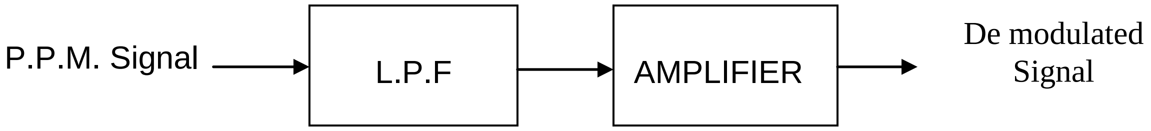
In PPM, the position of pulse is varied in accordance with message signal. Amplitude and width of the pulse is constant. PPM can be generated using astable or mono stable multi vibrators. The advantage of PPM is that it requires constant transmitter power but the disadvantage is depending on transmitter and the receiver synchronization. PPM can be generated easly from PWM, however in PWM the location of the leading edge is fixed where as trailing edge is not fixed. This position depends on pulse width, which is determined by the signal amplitude at that instant, PWM output is given to a differentiator which generated a positive spike to leading edge and negative edge to trailing edge. A simple diode clipper removes the positive spikes. The output goes from low to high and will be re mains in the same state (T=R*C). This constitutes a PPM signal. In de-modulation pulse position modulated signal is connected to a 4 th order low pass filter, which gives an analog signal (modulating signal). This being at low-level amplification. The low pass filter output connected to amplifier, which gives a true replica of input signal.

4. Block Diagram:

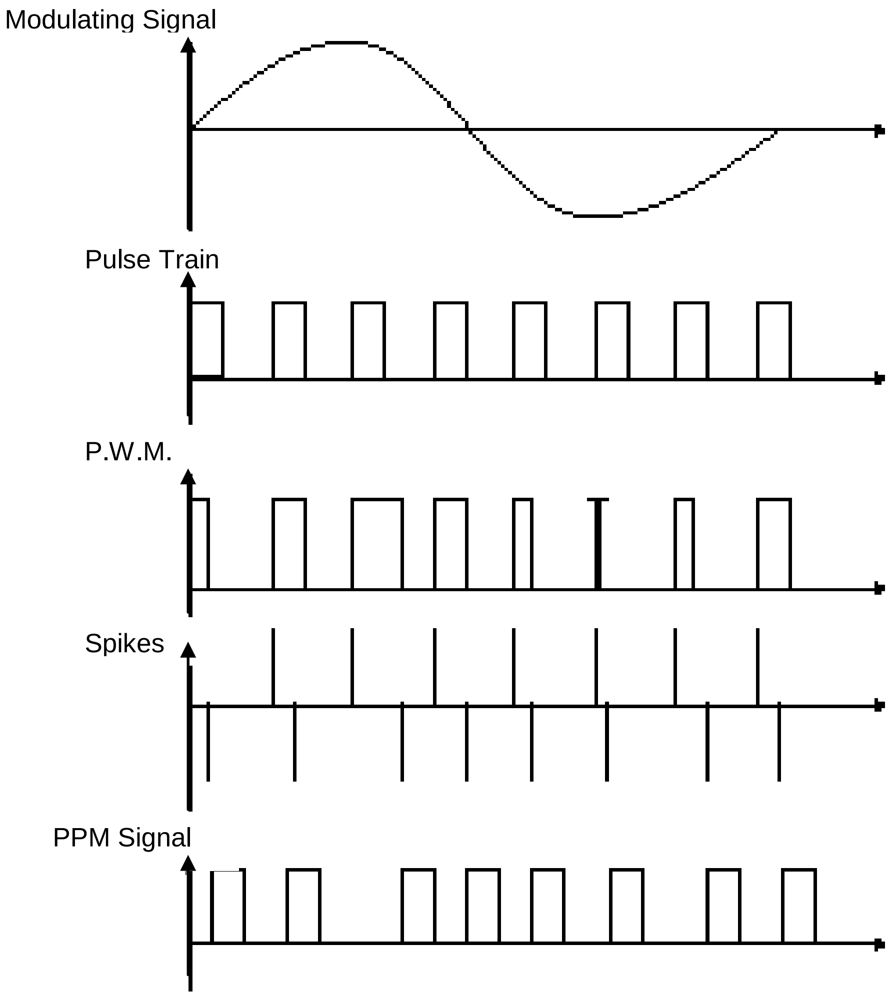
MODULATOR



DEMODULATOR



5.Model waveforms:



6. EXPERIMENTAL PROCEDURE:

6.1. Switch on the trainer kit.

8.2. 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,

8.3. Now monitor the output of the PPM modulator.

8.4. Observe position of the pulses in PPM output by varying amplitude of AF signal (Modulating signal).

8.5. For De-modulation PPM is applied as an input to PWM demodulator circuit which includes higher order low pass filter and AC amplifier.

8.6. As the output of LPF is having less amplitude, connect the output of LPF to input of AC Amplifier.

8.7. Observe the output of AC amplifier (at PWM de-modulator) which is a true replica of modulating signal (AF signal).

9. PRECAUTIONS:

7.1 Check for loose contacts of wires and components.

7.2 Keep all the control knobs in the minimum position.

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

7.4 Adjust the control knobs smoothly.

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

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

8. OBSERVATIONS:

8.1. Amplitude of the modulating signal_______________

8.2. Frequency of the modulating signal_________________

8.3. Amplitude of the De-modulating signal______________

8.4. Frequency of the De-modulating signal_______________

8.5. Sampling frequency___________________

9. CONCLUSION:

The pulse position modulation and demodulation is studied, verified and the out put waveforms are plotted.

10. VIVA -VOCE QUESTIONS:

10.1 Define PPM?

10.2 Give the expression for figure of merit a PPM system?

10.3 What is the Nyquist rate for uniform sampling?

10.4 What are the applications of PPM?

10.5 Why PWM signal is affected by noise compared to PPM?

10.6 What is Bandwidth required for PPM signal?

10.7 How to generate PPM from PWM signal?

10.8 Draw the block diagram for the detection of PPM signal.

10.9 What are the advantages and Advantages of PPM over PWM.

10.10 How to Demodulate PPM from PWM signal?

11. APPLICATIONS:

PPM is primarily useful for optical communications systems, where there tends to be little or no multipath interference. Pulse position modulation is also used for communication to the ISO/IEC 15693 contactless smart card as well as the HF implementation of the Electronic Product Code (EPC) Class 1 protocol for RFID tags.

EXPERIMENT NO: 11
PULSE POSITION MODULATION AND DEMODULATION

AIM:

To generate and detect PPM wave by using MATLABSoftware.

APPARATUS REQUIRED:

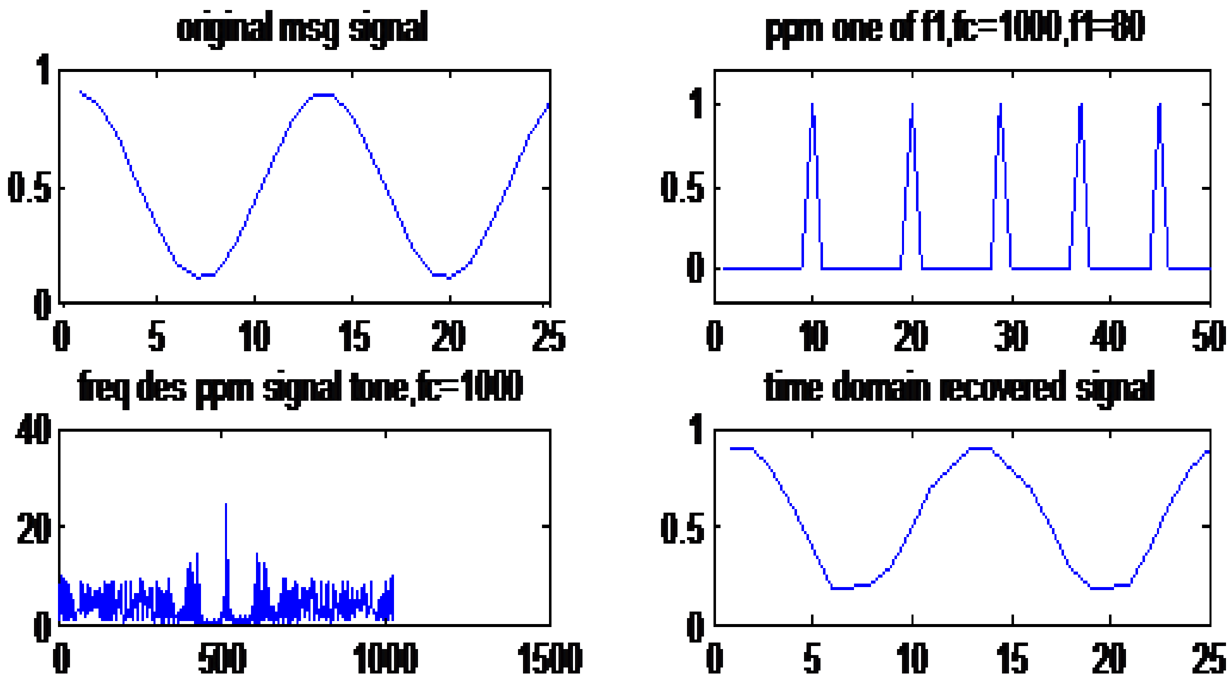
1.Computer

2. MATLAB

PROGRAM:

```
clc;
clear all;
close all;
fc=100;
fs=1000;
        f1=80;%f2=300
        t=0:1/fs:((2/f1)-(1/fs));
x1=0.4*cos(2*pi*f1*t)+0.5;
        %x2=0.2*(cos(2*pi*f1*t)+cos(2*pi*f2*t))+0.5 ;
subplot(4,2,1)
plot(x1)
title('original msg signal')
       y1=modulate(x1,fc,fs,'ppm')
subplot(4,2,2)
plot(y1)
axis([0 50 -0.2 1.2])
title('ppm one of f1,fc=1000,f1=80 ')
       fx1=abs(fft(y1,1024))
       fx1=[fx1(512:1024) fx1(1:513)]
       f=[(511*fs/1024):(fs/1024):(512*fs/1024)]
subplot(4,2,3)
plot(fx1)
title('freq des ppm signal tone,fc=1000')
       x1_recov = demod(y1,fc,fs,'ppm')
subplot(4,2,4)
plot(x1_recov)
title('time domain recovered signal')
```

Simulated Wave forms:



INFERENCE:
The PPM wave has been generated and detected by using MATLAB software.

EXERCISE:

1) Generate a PPM wave with message frequency 200hz and carrier frequency 2000Hz.
2) Detect a PPM wave with message frequency 200hz and carrier frequency 2000Hz.
3) Generate a PPM wave with message frequency 50hz and carrier frequency 1000Hz.
4) Detect a PPM wave with message frequency 50hz and carrier frequency 1000Hz.
5) Generate a PPM wave with message frequency 500hz and carrier frequency 10000Hz.
6) Detect a PPM wave with message frequency 500hz and carrier frequency 10000Hz.
7) Generate a PPM wave with message frequency 300hz and carrier frequency 2000Hz.
8) Detect a PPM wave with message frequency 300hz and carrier frequency 2000Hz.
9) Generate a PPM wave with message frequency 300hz and carrier frequency 5000Hz.
10) Generate a PPM wave with message frequency 300hz and carrier frequency 5000Hz.
11) Generate a PPM wave with message frequency 250hz and carrier frequency 2500Hz.
12) Detect a PPM wave with message frequency 250hz and carrier frequency 2500Hz.

13) Generate a PPM wave with message frequency 150hz and carrier frequency 1500Hz.
14) Detect a PPM wave with message frequency 150hz and carrier frequency 1500Hz.
15) Generate a PPM wave with message frequency 550hz and carrier frequency 15000Hz.
16) Detect a PPM wave with message frequency 550hz and carrier frequency 15000Hz.
17) Generate a PPM wave with message frequency 350hz and carrier frequency 2500Hz.
18) Detect a PPM wave with message frequency 350hz and carrier frequency 2500Hz.
19) Generate a PPM wave with message frequency 380hz and carrier frequency 6000Hz.
20) Generate a PPM wave with message frequency 380hz and carrier frequency 6000Hz.
21) Detect a PPM wave with message frequency 1100hz and carrier frequency 2500Hz.
22) Generate a PPM wave with message frequency 1200hz and carrier frequency 3300Hz.
23) Generate a PPM wave with message frequency 110hz and carrier frequency 2300Hz.
24) Generate a PPM wave with message frequency 1150hz and carrier frequency 4500Hz.
25) Detect a PPM wave with message frequency 1550hz and carrier frequency 4400Hz.

PHASE LOCKED LOOP as FM demodulator	EXPT. NO : 12
	DATE :

1. AIM:

1.6 To study the phase locked loop operation.

2. COMPONENTS & TOOLS REQUIRED:

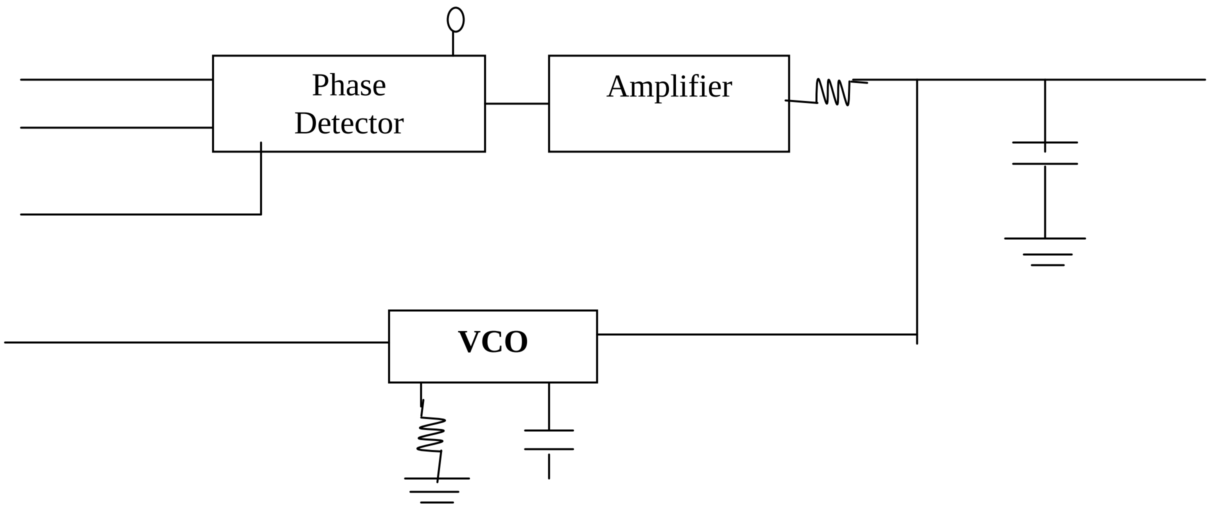
2. 1. Phase detector
2. 2. Amplifier
2. 3. VCO
2. 4. PLL Trainer Kit
2. 5. Cathode Ray Oscilloscope.
2. 6. Connecting wires

3. THEORY:

The phase locked loop can be used to track the phase and frequency of the carrier component of an incoming signal. Therefore it is a useful device for synchronous demodulation of AM. With suppressed carrier , it can be used for the demodulation of angle-modulated signals, especially under low SNR conditions. For this purpose PLL is used in such applications as space vehicle to earth data links and demodulation of commercial FM receivers.

PLL is used –ve feed back system, consists of three major components phase detector, loop filter and VCO. In typical feedback system, the signal is fed back to follow input signal, if the signal feedback is not equal to the input signal, the difference will change the signal feedback until it is close to the input signal. A PLL operates on a similar principle except that the quantity fed back and compared is not amplitude, but the phase. The VCO adjusts its own frequency until it is equal to that of the input sinusoid, In practical VCO can generate either sinusoidal or square signals.

4. BLOCK DIAGRAM:



4.1 BLOCK DIGRAM DISCRIPTION:

4.1.1 Square generator: It generates a square wave with range of frequency (1 to 10 khz) a heliport (potentiometer) is provided for fine adjustment for frequency, which is applying for PLL circuit as an input.

4.1.2 Phase locked loop: The 1m 565 from national semiconductor is a 14 input IC that can be connected to external components from a PLL. Differential inputs pin 2 & 3 are grounded through 1 k-ohm and single ended input is applied to pin 2, in this way VCO output becomes an input to phase detector, locked output is taken at pin 4.

Free – running frequency (Fo)

When there is no input to the pin 2 PLL said to be in free running mode with its frequency determined by its circuit elements Rt and Ct.

Free running frequency Fo = 0.3 / (Rt * Ct).

Where Rt = Timing resistor AND Ct = Timing capacitor.

Lock range (F_L)

Lock range of PLL is the range of frequencies in which the already locked PLL will remain in lock and this is given by

(F_L) = 8 fo / Vt = supply voltage (+Vcc-(- Vcc)).

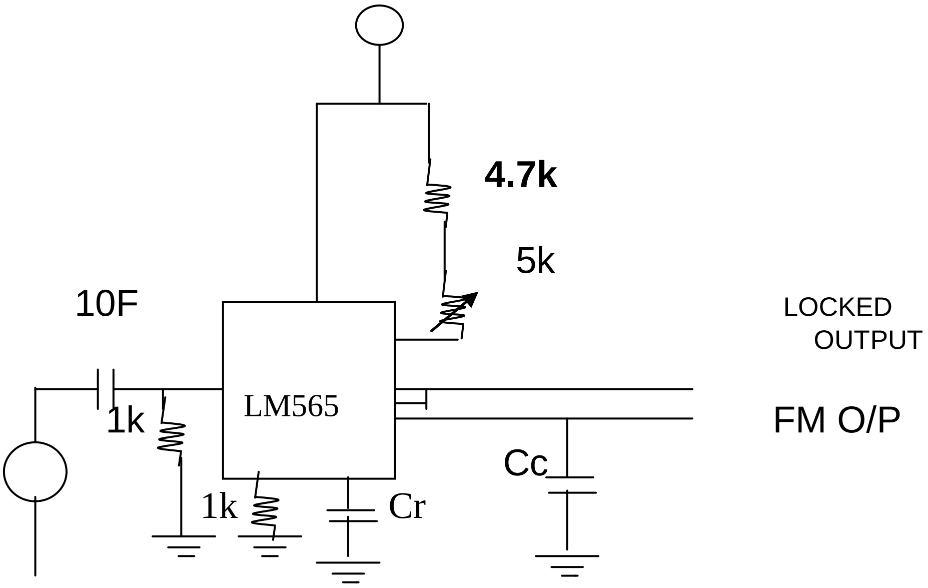
Capture range (Fc)

The capture range of the PLL is the range of frequencies on which it will lock prior to being in lock. The capacitor Cc and internal resistor 3.6K-ohm from a low pass RC filter to remove the original frequencies, this harmonics, and the sum frequency and the approximately given by

Fc =__________

5. CIRCUIT DIGRAM:

PLL CIRCUIT DIAGRAM USING LM 565



6. TABULAR COLUMNS:

For free running frequency: - fo = 0.3 / $R_t * C_t$

R_t value (pot position)	Theoretical value (f_o) HZ	Practical value (f_o) HZ

Lock range : (f_1)

Theoretical value	Practical value

Capture range (f_c) :

Filter capacitor Cc	Theoretical value	Practical value
0.1uf		
0.2uf		

7. EXPERIMENTAL PROCEDURE:

Free running frequency:

7.1 Switch on the trainer and measure the output of the power supply + 12v and +5v.

7.2 Observe the output of the square wave generator-using CRO and measure the frequency range with help of frequency counter. Frequency range should be around 1khz to 10khz.

7.3 Calculate the free running frequency range of the circuit for different values of timing resistors Rt (To measure Rt switch off the trainer and measure the value using multimeter) and record in tabular form.

7.4 Connect the capacitor to the circuit and open the loop by removing short between pin 4 and 5 . Measure the min max free running frequencies obtained at the output of the PLL (pin4) by varying the pot. Compare your results with theoretical value simultaneously you can observe the waveform on CRO.

Lock range:

7.5 Calculate the lock range of the circuit for 5KHZ free running frequency and record in the table.

7.6 Connect pins 4 and 5 with help of springs and adjust the potentiometer to get a free running frequency 5KHZ. Connect square waveform output to the PLL circuit. Provide a 5KHZ square signal of 1V $_{pp}$ approximately (make this close to VCO frequency as possible).

7.7 Connect the frequency counter to the input and output of PLL.

7.8 Observe the input and output frequencies while slowly increasing the frequency of the square wave at the input. For some range output and input are equal. A9 this is known as locking and PLL said to be locked with input signal. Record frequency at which the PLL breaks lock (output frequency of the PLL will be around VCO frequency and in CRO you will see a jitter waveform when it breaks lock instead of clear square wave). This frequency is called as upper end of the lock range and record this frequency as F1.

7.9 Beginning with 5KHZ, slowly decrease the frequency of input and determine the frequency at which the PLL breaks the lock on lower end of and record it as F2.

7.10 Find lock range from (F2 – F1) and compare with theoretical value.

Capture range:

7.11 Calculate the capture range of the circuit for 5KHZ free running frequency let filter capacitor Cc is 0.1uf.

7.12 With CRO slowly increase the input frequency from min (1KHZ). Record the frequency (as F3) at which input and output frequencies of the PLL equal, this is known as lower end of the capture range.

7.13 Now keep the frequency at the max possible (say 10KHZ) and slowly reduce and record the frequency (as F4) at which input and output frequencies of the PLL equal, this is known as upper end of the capture range.

7.14 Calculate capture range from (F4 – F3) and compare with the theoretical value.

7.15 Repeat the above steps by considering the value of Cc is 0.2uf.

8. PRECAUTIONS:

Check for loose contacts of wires and components.

Keep all the control knobs in the minimum position.

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

8.4 Adjust the control knobs smoothly.

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

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

9. OBSERVATIONS:

9.1 Amplitude of input signal = ------------------------ v

9.2 Frequency of input signal = ------------------------KHz

9.3 Free running frequency = ------------------------KHz

9.4 Capture range = -----------------------KHz

F4 = --------------------KHz

F3 = --------------------KHz

9.5 Locked range = ------------------------KHz

F2 = --------------------KHz

F1 = --------------------KHz

10. CONCLUSION:

The behavior of the PLL is studied and verified in free running range, lock range and capture range.

11. VIVA -VOCE QUESTIONS:

11.1 What is the use of PLL?

11.2 What is the application of PLL?

11.3 What are the main blocks in PLL?

11.4 What is meant by capture range?

11.5 What is meant by free running range?

11.6 Draw the block diagram for the detection of FM signal

11.7 What is the use of phase detector in PLL?

11.8 What is Bandwidth required for FM signal?

11.9 What is the condition for phase lock in PLL?

11.10 What is the frequency of a VCO in PLL.

12. APPLICATIONS:

Phase locked loops are widely employed in radio, telecommunications, computers and other electronic applications. They can be used to demodulate a signal, recover a signal from a noisy communication channel, generate a stable frequency at multiples of an input frequency (frequency synthesis), or distribute precisely timed clock pulses in digital logic circuits such as microprocessors. Since a single integrated circuit can provide a complete phase-locked-loop building block, the technique is widely used in modern electronic devices, with output frequencies from a fraction of a hertz up to many Gigahertz.

Verification of Sampling Theorem	EXPT. NO : 13
	DATE :

AIM: -

To observe the number of samples by applying the modulating signal with frequency 500Hz and 1KHz with clock frequency 20KHz.

Equipment required: -

Sampling theorem trainer kit.
Function generator
CRO
BNC cable
Patch cards

Theory: -

The sampling process is usually described in the time domain as such it is as operation that is basic to digital signal processing and digital communications. Though use of the sampling process an analog signal is converted into a corresponding sequence of samples that are usually spaces uniformly is time clearly for such a procedure to have practical utility it is necessary that we choose the sampling rate properly so that the sequence of samples uniquely defines the original signal this is the senesce of the sampling theorem.

Consider an arbitrary signal x (t) of finite energy which is specified for all time suppose that we sample the signal x (t) instantaneously and at a uniform rate, once every t_s seconds consequently we obtain an infinite sequence of samples spaced t_s seconds apart and denoted by {x (nt_s)}. T_s are the sampling period and its reciprocal fs=1/ts is the sampling rate. This ideal form of sampling is called instantaneous sampling.

Xs (t) =

Where Xs (t) is the ideal sampled signal

We may state the sampling theorem for strictly band limited signals of finite energy is two equivalent parts, which apply to the transmitter and receiver of a pulse modulation system.

Time domain statement: -

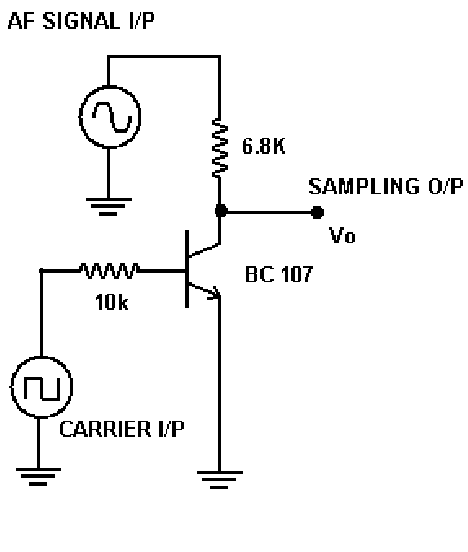
A band limited signal of finite energy and finite duration, which has no frequency components higher than fm Hz is completely described by specifying the values of the signal at instants of time serrated by 1/2fm, seconds.

Frequency domain statement: -

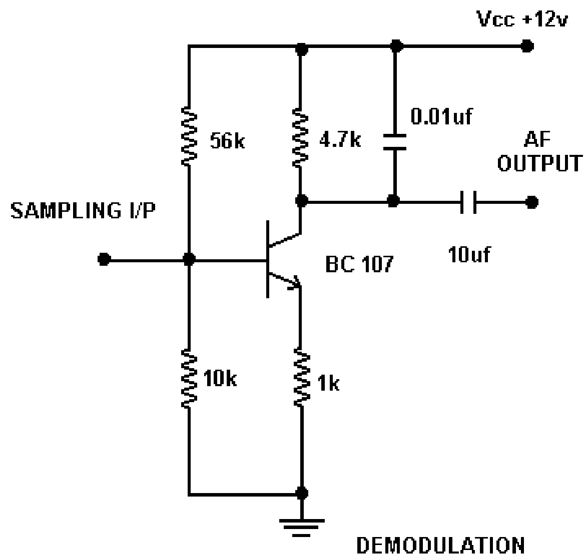
A band-limited signal of finite energy, which has no frequency components higher than f_m Hz, may be completely recovered form, knowledge of its samples taken at the rate of $2f_m$ samples per second. The sampling rate of $2f_m$ samples per second for a signal bandwidth of

f_m Hz is called the Nyquist rate and its reciprocal of $1/2f_m$ is called the Nyquist interval. This equation provides an interpolation formula for reconstructing the original signal x (t) form the sequence of samples values x ($n/2f_m$), with the sine function since (2fmt) playing the role of an interpolation function each sample is multiplied by a delayed version of the interpolation function and all resulting waveforms are added to obtain x (t).

CIRCUIT DIAGRAM

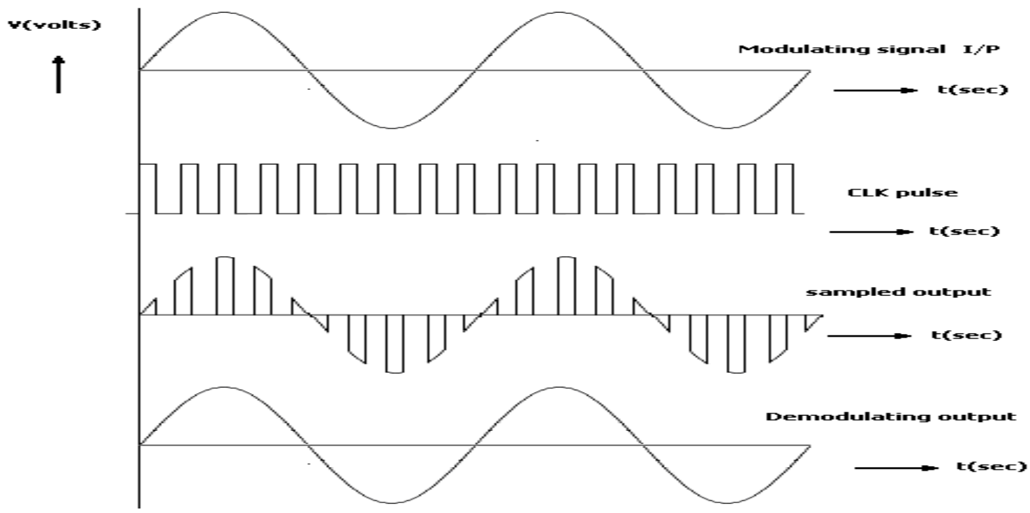


MODULATION



DEMODULATION

MODEL GRAPH



Procedure: -

1. Connect the circuit as per the circuit diagram.
2. Apply a modulating signal of frequency 1 kHz and a clock pulse of frequency 18KHz
3. Observe the sampled waveform on CRO and find the number of samples obtained.
4. Compare it with theoretical value and verify it draw the waveform of the sampled signal.

Results: - Verification of sampling theorem is done successfully for three sinusoidal signals

Applications: The sampling theorem is usually formulated for functions of a single variable. Consequently, the theorem is directly applicable to time-dependent signals and is normally formulated in that context. However, the sampling theorem can be extended in a straightforward way to functions of arbitrarily many variables**.**

VIVA QUESTIONS

1. Define sampling theorem.
2. What is sampling?
3. Define band limited signals?
4. What is aliasing effect?

5. How can be aliasing be avoided?
6. What is under sampling?
7. Define Nyquist rate?
8. What is sampling frequency?
9. What is modulating frequency?
10. What is sampling rate?

FREQUENCY SYNTHESIZER

EXPT. NO : 14

DATE :

AIM: To study the operation of frequency synthesizer using PLL

APPARATUS:
1. Frequency synthesizer trainer
2. Dual traces C.R.O (20 MHZ)
3. Digital frequency counter or multimeter
4. Patch chords

THEORY:

PLL stands for „Phase locked loop" and it is basically a closed lo op frequency control system, whose functioning is based on phase sensitive detection of phase difference between the input and output signals of controller oscillator. Before the input is applied the PLL is in free running state. Once the input frequency is applied the VCO frequency starts change and phase locked loop is said to be in captured mode. The VCO frequency continues to change until it equals the input frequency and PLL is then in the phase locked state. When phase locked the loop tracks any change in the input frequency through its repetitive action.

Frequency Synthesizer:

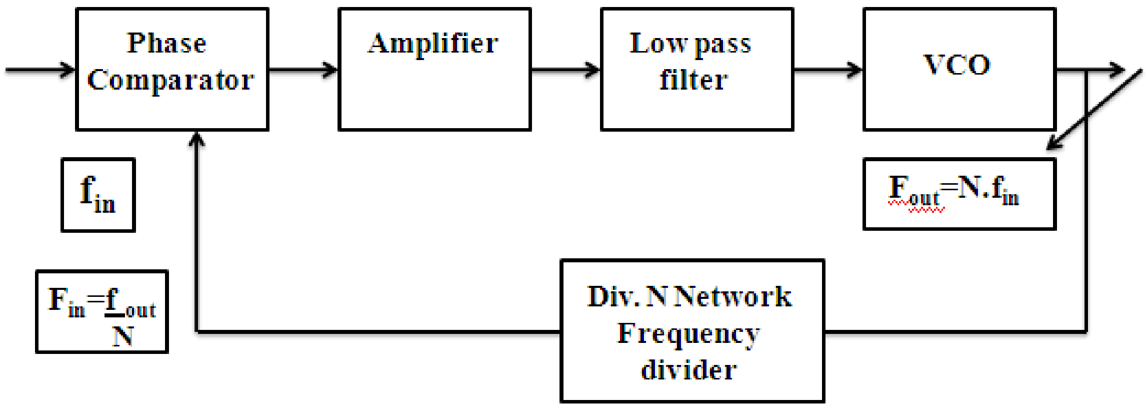
The frequency divider is inserted between the VCO and the phase comparator. Since the output of the divider is locked to the input frequency fin, VCO is running at multiple of the input frequency. The desired amount of multiplication can be obtained by selecting a proper divide by N network. Where N is an integer. For example fout= 5 fin a divide by N=10, 2 network is needed as shown in block diagram. This function performed by a 4 bit binary counter 7490 configured as a divide by 10, 2 circuit. In this circuit transistor Q1 used as a driver stage to increase the driving capacity of LM565 as shown in fig.b. To verify the operation of the circuit, we must determine the input frequency range and then adjust the free running frequency Fout of VCO by means of R1 (between 10^{th} and 8^{th} pin) and CI (9^{th} pin), so that the output frequency of the 7490 driver is midway within the predetermined input frequency range.

The output of the VCO now should 5Fin .

Free running frequency (f0): Where there is no input signal applied, it is in free running mode. F0 = 0.3 / (RTCT) where RT is the timing resistor CT is the timing capacitor.

Lock range of PLL(fL)FL= +8f0/Vcc where f0is the free running frequency=2VCC

CIRCUIT DIAGRAM:



PROCEDURE:

1. Switch on the trainer and verify the output of the regulated power supply i.e. + 5V. These supplies are internally connected to the circuit so no extra connections are required.

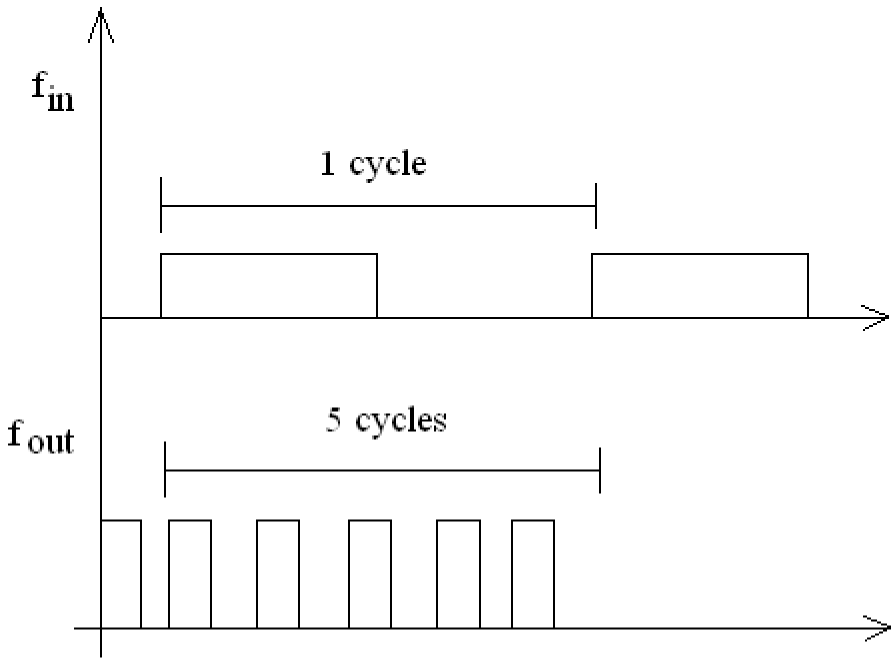
2. Observe output of the square wave generator using oscilloscope and measure the range with the help of frequency counter, frequency range should be around 1 KHz to 10 KHz.

3. Calculate the free running frequency range of the circuit (VCO output between 4th pin and ground). For different values of timing resistor R1 (to measure Rt switch off the trainer and measure Rt value using digital multimeter between given test points) . and record the frequency values in tabular 1. Fout = 0.3 /(RtCt) where Rt is the timing resistor and Ct is the timing capacitor =0.01 µf.

4. Connect 4th pin of LM 565 (Fout) to the driver stage and 5th pin (Phase comparator) connected to 11th pin of 7490. Output can be taken at the 11th pin of the 7490. It should be divided by the 10, 2 times of the fout.

EXPECTED WAVEFORMS:

Input waveforms



Output waveforms

RESULT: Verified the operation of frequency synthesizer using PLL is Studied.

VIVA QUESTIONS

1. **What is meant by Frequency synthesizer?**
2. **What are the applications of Frequency synthesizer?**
3. **How does frequency synthesizer works?**
4. **What are the advantages of frequency synthesizer?**
5. **What are the disadvantages of frequency synthesizer?**
6. **What is PLL?**
7. **What is acronym of VCO?**
8. **What is frequency stability?**
9. **What is acronym of PLL?**

PROGRAM:-

```
% program for frequency synthesizer
close all;
clear all;
clc
fs = 10000;
t = 0:1/fs:1.5;
f=50;
x1 = square(2*pi*f*t);
subplot(3,1,1)
plot(t,x1); axis([0 0.2 -1.2 1.2])
xlabel('Time (sec)');ylabel('Amplitude');
title('Square wave input with freq=50HZ');
t = 0:1/fs:1.5;
x2 = square(2*pi*2*f*t);
subplot(3,1,2)
plot(t,x2); axis([0 0.2 -1.2 1.2])
xlabel('Time (sec)');ylabel('Amplitude');
title('frequency multiplication by a factor of 2');
x3 = square(2*pi*f/2*t);
subplot(3,1,3)
plot(t,x3); axis([0 0.2 -1.2 1.2])
xlabel('Time (sec)');ylabel('Amplitude');
title('frequency division by a factor of 2');
```

AGC CHARACTERISTICS	EXPT. NO : 15
	DATE :

AIM: To study the operation of AGC in communication system.

APPARATUS:

1. Trainer Kit
2. Dual trace oscilloscope
3. Digital multi meter.

THEORY:

A Simple AGC is a system by means of which the overall gain of a radio receiver is varied automatically with the changing strength of the received signal, to keep the output substantially constant. A dc bias voltage, derived from the detector. The devices used in those stages are ones who‟s trans-conductance and hence gain depends on the applied bias voltage or current. It may be noted in passing that, for correct AGC operation, this relationship between applied bias and trans-conductance need not to be strictly linear, as long as trans-conductance drops significantly with increased bias. All modern receivers are furnished with AGC, which enables tuning to stations of varying signal strengths without appreciable change in the size of the output signal thus AGC "irons out" input signal amplitude variations, and the gain control dose not have to be re adjusted every time the receiver is tuned from one station to another, except when the change in signal strengths is enormous. In addition, AGC helps to smooth out the rapid fading which may occur with long-distance short-wave reception and prevents the overloading of last IF amplifier which might otherwise have occurred.

CIRCUIT DESCRIPTION:

RF Generator:

Colpitts oscillator using FET is used here to generate RF signal of 455 KHz frequency to use as carrier signal in this experiment. Adjustments for amplitude and frequency are provided on panel for easy operation

AF generator:

Low frequency signal of approximately 1 KHz is generated using op-amp based wine bridge oscillator; required application and adjustable attenuation are provided

Regulated power supply:

This consist of bridge rectifiers, capacitor filters and thee terminal regulators to provide required dc voltages in the circuit i.e. +12v, -12v, +6v @150mA each

AM MODULATOR:

Modulator section illustrates the circuit of modulating amplifier employing transistor (BC 107) as an active device in common emitter amplifier mode. R1 and R2 establish quiescent forward bias for the transistor. The modulating signal is fed at the emitter section causes the bias to increase or decrease in accordance with the modulating signal. R4 is emitter resistance and C3 is by pass capacitor for carrier. Thus the carrier signal applied at the base gets amplified more when the amplitude of the modulating signal is at its maximum and less when the signal by the modulating signal output is amplitude- modulated signal. C2 couples the modulated signal to output of the modulator.

Detector and AGC Stage:

This circuit incorporates two-stage amplifier, diode detector and AGC circuit.

1st IF amplifier

Q2 (BF 495c) acts as 1st if amplifier. The base of Q2 is connected through R5 (68k0 to the detector output .R6 (100E) and C4 (47n) is decoupling filter for +B line. The base potential depends on R4 (220k) base biasing resistor and detector current supplied by R5. The detector current is proportional to the signal strength received. This is called A.G.C C6 (4.7/16) is used as base bias and AGC decoupling capacitor C18 (2n7). This is given to the base of Q3 (BF 495D).

2nd IF AMPLIFIER

Q3 (BF 195C) acts as 2nd IF amplifier. The base bias for Q3 is provided by R7 (180k), C7 (47) is used to keep the end 4of L8 (IFT2) at ground potential for if signal. The collector of Q3 is connected to the L9 (IFT3). L9 contains 200pf capacitor inside across the primary. The output of Q3 is available across the secondary of L9, the primary of which tuned by the internal 200pf capacitor. R8 (220e), C8 (47n) consists the decoupling circuit for the collector supply of Q3. The output of Q3 is coupled to detector diode D1 (OA 79).

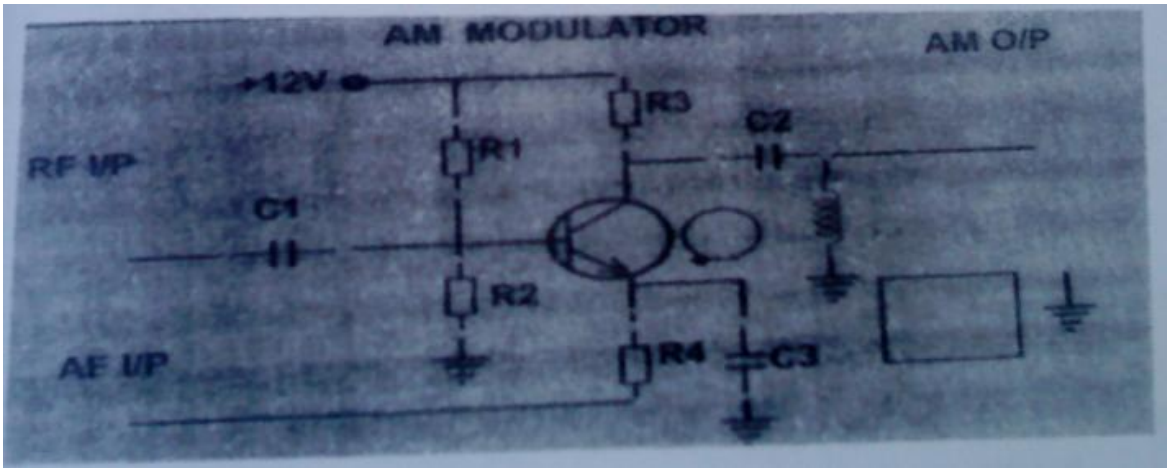
Detector

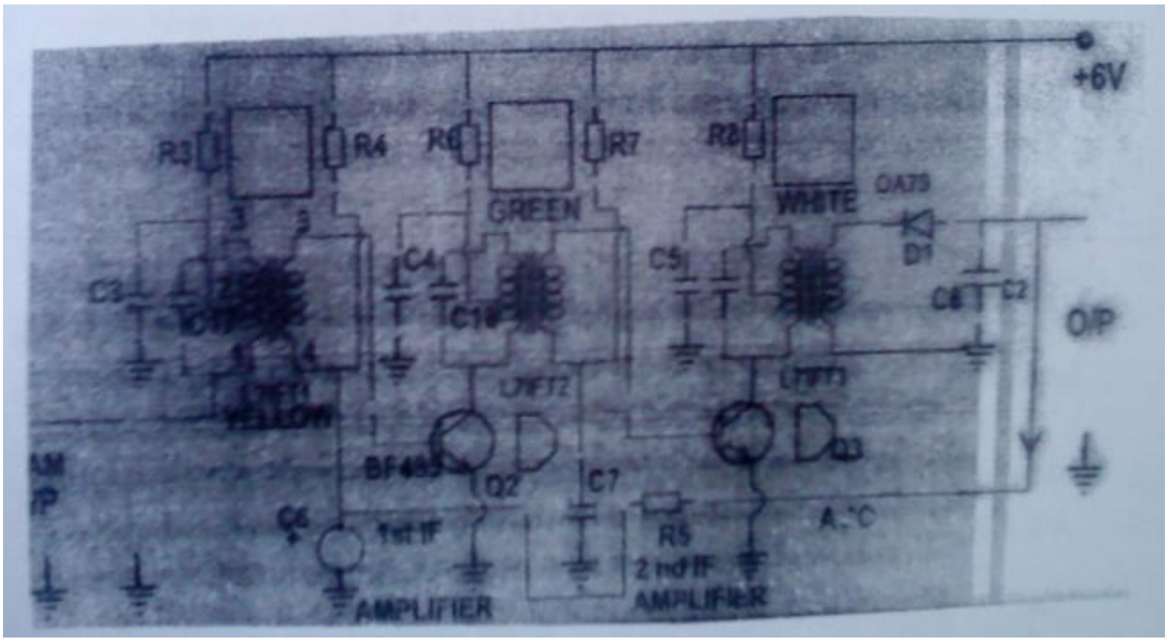
Modulated IF signal from the secondary of L9 (IFT3) is fed to the detector diode D1D1 rectifies the modulated if signal &if component of modulated signal is filtered by c8 (22n),r9(680e0&c14(22n).r9 is the detector load resistor. The detected signal (AF signal) is given to the volume control P2 (10k Log) tough maximum audio output-limiting resister r21 (10k). It is also given to AGC circuit made of R5 (68k) and C6 (a.7/16).

AGC:

The Sound received from the LS will depend on the strength of the signals received at the antenna. The strength of the received signals can vary widely due to fading. This will cause variations in sound which can be annoying. Moreover, the Strength of signals can also be too large in close vicinity of MW transmitters causing overloading of 2nd IF amplifier. Automatic gain control (AGC) is used to minimize the variations in sound with changes in Signals strength & to prevent overloading. The operation of AGC depends on the fact that The gain obtained from any transistor depends on its collector current & becomes less When the collector current is reduced to cut off (or increased to saturation For AGC, DC voltage obtained from the detection of IF signals is applied to the 1st amplifier transistor base in such a way that an increase in this voltages reduces the gain of the transistor. The result is that when the strength of the incoming signal increases, the DC voltage also increases and this tends to reduce the gain of the amplifier thus not permitting the output to change much. Here R5 (68k) C6 (4.7/16) performs this function. C6 (4.7/16) is the AGC decoupling capacitor to by pass any AF signals and keep the bias steady.

CIRCUIT DIAGRAM:





Figure

PROCEDURE:

1. As the circuit is already wired you just have to trace the circuit according to the Circuit diagram given above Fig1.1.

2. Connect the trainer to the mains and switch on the power supply.

3. Measures the output voltages of the regulated power supply circuit i.e. +12v and -12v,+6@150ma.

4. Observe outputs of RF and AF signal generator using CRO, note that RF voltage is approximately 50mVpp of 455KHz frequency and AF voltage is 5Vpp of 1KHZ frequency.

5. Now vary the amplitude of AF signal and observe the AM wave at output, note the Percentage of modulation for different value of AF signal.

%Modulation= (B-A)/ (B+A) X 100

6. Now adjust the modulation index to 30% by varying the amplitudes of RF & AF Signals simultaneously.

7. Connect AM output to the input of AGC and also to the CRO channel-1.

8. Connect AGC link to the feedback network through OA79 diode

9. Now connect CRO channel-2 at output. The detected audio signal of1 KHz will be observed.

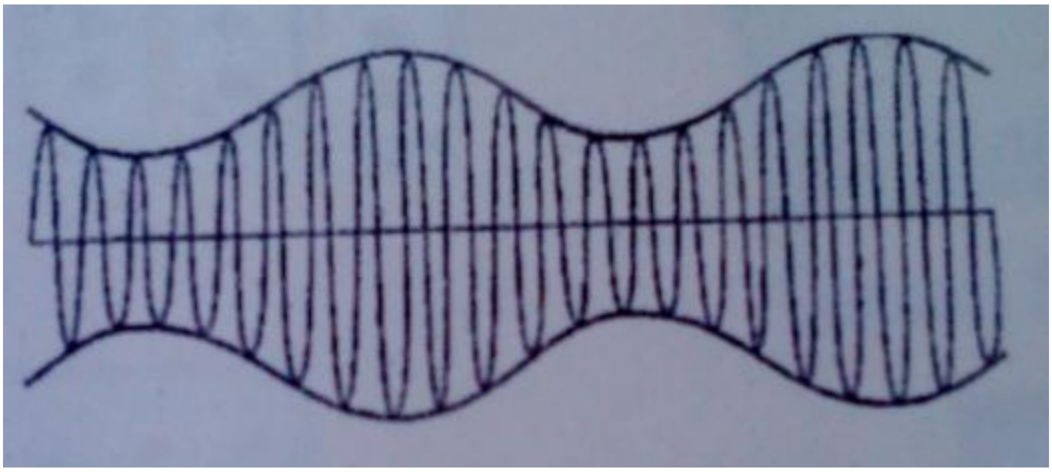
10. Calculate the voltage gain by measuring the amplitude of output signal (Vo) waveform, using formula A = Vo/Vi.

11. Now vary input level of 455 KHz IF signal and observe detected 1 KHz audio Signal with and without AGC link. The output will be distorted when AGC link removed i.e. there is no AGC action.

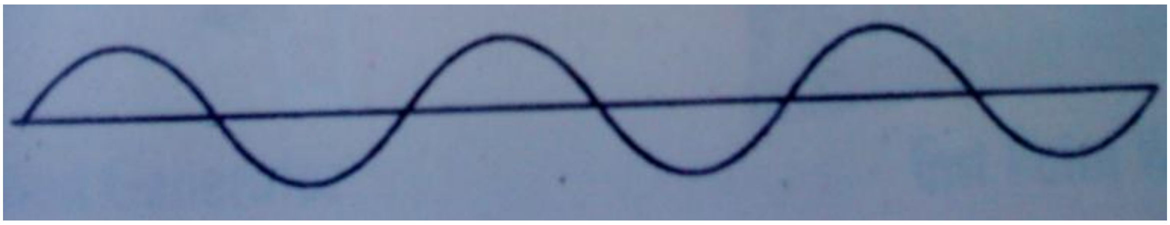
12. This explains AGC effect in Radio circuit.

EXPECTED WAVEFORMS:

AF Modulated RF Output:



Detected output with AGC:



RESULT: Verified the characteristics of Automatic Gain Control

PROGRAM:

```
% program for AGC
close all
clear all
clc
Fs = 100e3; %sampling freq
t = 0:1/Fs:.1-1/Fs; % time variable
Am=2;
fm = 200; %fm 200 Hz
m = cos(2*pi*fm*t); %message signal
Fc = 3e3;
% am modulation
Ac = 8;
c=Ac.*cos(2*pi*Fc*t); %carrier signal
figure;
% ploting message and carrier signals
subplot(2,1,1);
plot(c);
title('carrier');xlabel('time');ylabel('amplitude');
subplot(2,1,2);
plot(m);
title('message');xlabel('time');ylabel('amplitude');
figure;
% ploting AM modulated output
s = ammod(m,Fc,Fs,0,Ac);
subplot(2,1,1);
plot(s);
title('am modulation ');xlabel('time');ylabel('amplitude');
z = amdemod(s,Fc,Fs,0,Ac);
subplot(2,1,2);
plot(z);
title('am demodulation ');xlabel('time');ylabel('amplitude');
```