ANALOG COMMUNICATION LAB
(04 1x03)

LABORATORY MANUAL

Bhagalpur College of Engineering, Bhagalpur

FACULTY NAME: ANSHU KUMARI
ASSISTANT PROFESSOR
Department of

Electronics and Communication Engineering

List of Experiments

1. Generation of different types of signals-sinusoidal, square waves at different frequencies and Fourier series representation of sinusoidal signal using software tool(SIMULINK, VISSIM).
2. Analysis of the process of Frequency Division Multiplexing and demultiplexing.
3. Study of generation and detection of Amplitude Modulated signal.
4. Study of generation and detection of DSB-SC Modulated signal.
5. Study of generation and detection of SSB-SC Modulated signal.
6. Study of generation and detection of FM Modulated signal.
7. Study of generation and detection of Pulse Amplitude Modulation (PAM).
8. Study of generation and detection of Pulse Width Modulation (PWM).
9. Study of generation and detection of Pulse Position Modulation (PPM).
10. Study of Superhetrodyne receiver.

EXPERIMENT No.-1

TITLE: Generation of signals and Fourier series representation.

AIM OF THE EXPERIMENT: Generation of different types of signals-sinusoidal, square waves at different frequencies and Fourier series representation of sinusoidal signal using software tool(SIMULINK, VISSIM).

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	PC loaded with MATLAB-SIMULINK software		**1**
2.			

THEORY:

In mathematics, a **Fourier series** is a way to represent a function as the sum of simple sine waves. More formally, it decomposes any periodic function or periodic signal into the sum of a (possibly infinite) set of simple oscillating functions, namely sine and cosines.

The **Dirichlet conditions** are sufficient conditions for a real-valued, periodic function *f* to be equal to the sum of its Fourier series at each point where *f* is continuous.

The conditions are[1]:

1. *f* must be absolutely integrable over a period.
2. *f* must be of bounded variation in any given bounded interval, i.e. there must be a finite number of maxima and minima in the interval.
3. *f* must have a finite number of discontinuities in any given bounded interval, and the discontinuities cannot be infinite.

The Fourier series of a periodic signal f(x) can be written as

$$f(x) = a_0 + \sum_{n=1}^{\infty}\left[a_n \cos\left(\frac{n\pi x}{L}\right) + b_n \sin\left(\frac{n\pi x}{L}\right)\right]$$

$$a_0 = \frac{1}{2L}\int_{-L}^{L} f(x)\,dx$$

$$a_n = \frac{1}{L}\int_{-L}^{L} f(x)\cos\left(\frac{n\pi x}{L}\right)dx$$

$$b_n = \frac{1}{L}\int_{-L}^{L} f(x)\sin\left(\frac{n\pi x}{L}\right)dx$$

PROCEDURE:

1. Open the MATLAB software then go to Simulink.
2. Open new file for the simulation.
3. Go to Simulink library and select the blocks as mentioned in block diagram.
4. Connect wires as per connection.
5. Then run it.
6. Observe the waveform on scope and verify it.
7. Save the block diagram and waveforms.

BLOCK DIAGRAM:

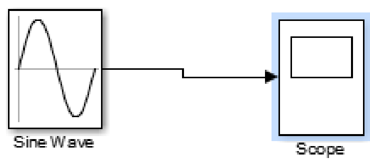


Fig1.1: Block diagram of Sinusoidal wave generation

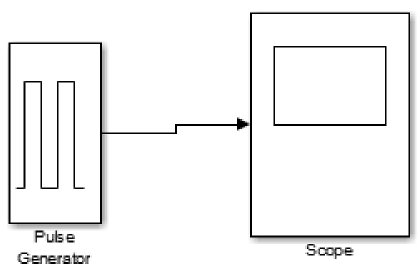


Fig1.2: Block diagram of Square wave generation

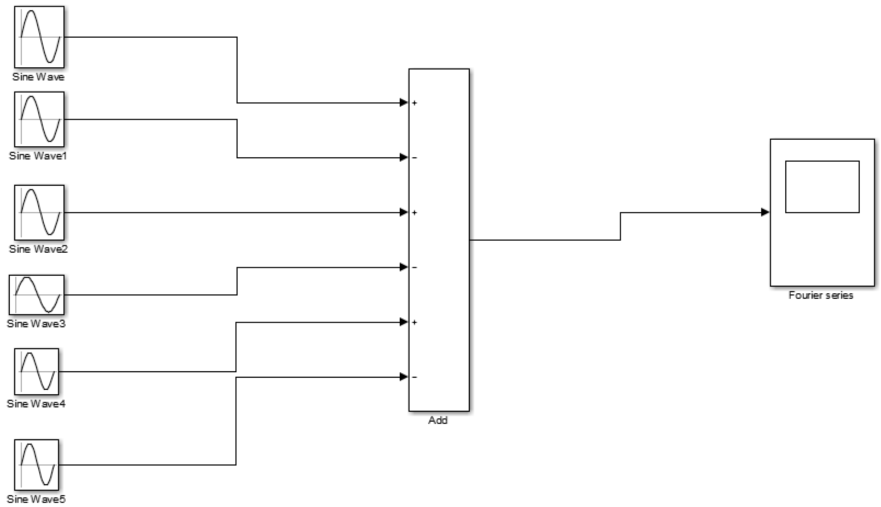


Fig1.3: Block diagram of Fourier Series representation of Sinusoidal wave

GRAPH:

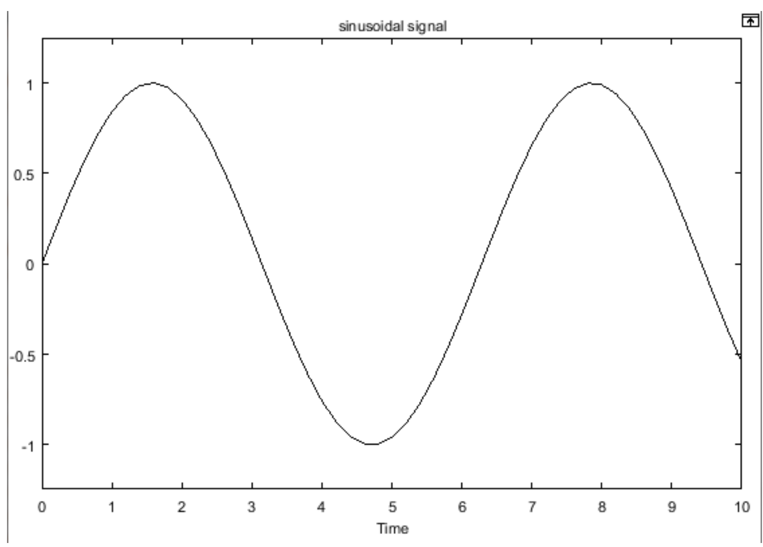


Fig1.4: Sinusoidal wave

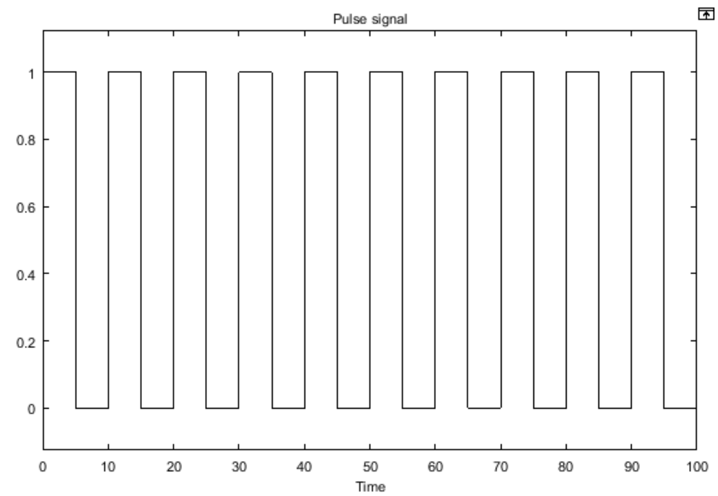


Fig1.5: Square wave

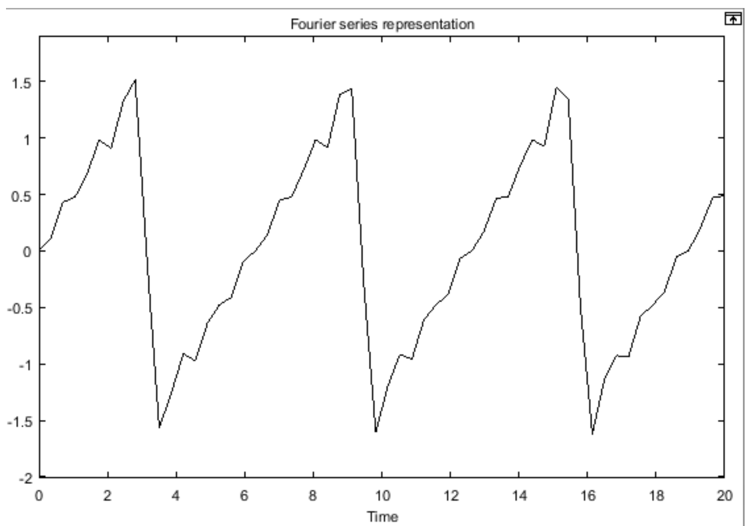


Fig1.6: Fourier series representation of Sinusoidal wave

OBSERVATION: Write Amplitude, time- period and frequency of the sinusoidal, square and Fourier representation of sinusoidal signal.

RESULTS: Different signals are generated and studied successfully.

CONCLUSION: From the above experiment, we have concluded that Fourier series representation of sinusoidal signal is a Ramp or Saw-tooth wave form

PRECAUTIONS:

1. MATLAB Software should be handled carefully.

<u>**EXPERIMENT No.-2**</u>

TITLE: FDM multiplexing and demultiplexing.

AIM OF THE EXPERIMENT: To analysis of the process of Frequency Division Multiplexing and demultiplexing.

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	FDM kit		1
2.	Digital Storage Oscilloscope(DSO)	100MHz,1GSa/S	1
3.	Power Supply		1
4.	Patch Cords		As per requirement

THEORY:

FDM is a technique in which numerous signals are combined for transmission on a singal communication channel. Each signal is assigned a different frequency within the main channel. When FDM is used in a communication network, each input signal is sent and received at maximum speed at all times. However if many signals are sent along a single channel, the necessary bandwidth is large. The most natural example of frequency division multiplexing is radio and television broadcasting, in which multiple radio signals at different frequencies pass through the air at the same time.

PROCEDURE:

1. The connections are made as per the block diagram.
2. Connect the power supply in proper polarity to the kit and switch it on.
3. Observe the following waveforms at the
    a. Input Channel
    b. Multiplexer output
    c. Reconstructed signal

   And plot it on graph paper.

   BLOCK DIAGRAM:

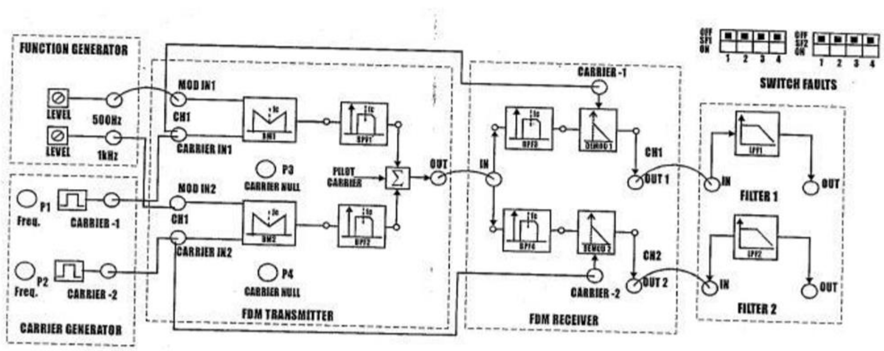
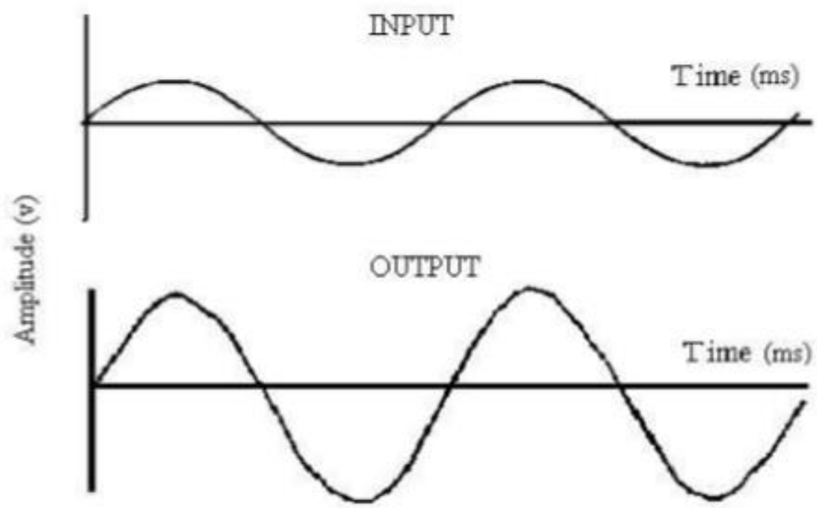


Fig2.1: Block diagram of FDM

GRAPH:



OBSERVATION:

Sl.No.	Signal	Amplitude(V)	Time Period(s)	Frequency(Hz)
1.	Input1			
2.	Input2			
3.	Carrier1			
4.	Carrier2			
5.	Modulated Input			
6.	Demodulated Output 1			
7.	Demodulated Output 2			

RESULTS: FDM modulation and demodulation are verified in the hardware kit and its waveforms are studied.

CONCLUSION: From the above experiment, we obtain the amplitude and frequency of output signal are ……….and………respectively.

PRECAUTIONS:

1. Do not use open ended wires to connect 230V, 50Hz power supply.
2. Check the connection before giving the power supply.
3. Observations should be done carefully.
4. Disconnect the circuit after switched off the power supply.

EXPERIMENT No.-3

TITLE: Generation and detection of AM signal.

AIM OF THE EXPERIMENT: To study the generation and incoherent detection / envelope detection/diode peak detection of AM signal (DSB with carrier).

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	AM modulation and demodulation kit		1
2.	Digital storage oscilloscope	100MHz,1GSa/S	1
3.	Patch cord		
4.	Connecting wires		**As per requirment**

THEORY:

Modulation is defined as the process by which some characteristics of a carrier signal is varied in accordance with a modulating signal. The base band signal is referred to as the modulating signal and the output of the modulation process is called as the modulated signal.

AMPLITUDE MODULATION

Amplitude modulation is defined as the process in which amplitude of the carrier wave is varied in accordance with the instantaneous values of the modulating signal. The envelope of the modulated wave has the same shape as the base band signal provided the following two requirements are satisfied-

1. The carrier frequency f_c must be much greater then the highest frequency components f_m of the message signal m (t) i.e. fc >>fm
2. The modulation index must be less than unity. If the modulation index is greater than unity, the ca rrier wave becomes over modulated.

AMPLITUDE DEMODULATION

The process of detection provides a means of recovering the modulating Signal from modulated signal. Demodulation is the reverse process of modulation. The envelope detector circuit is employed to separate the carrier wave and eliminate the side bands. Since the envelope of an AM wave has the same shape as the message, independent of the carrier frequency and phase, demodulation can be accomplished by extracting envelope.

An increased time constant RC results in a marginal output follows the modulation envelope. A further increase in time constant the discharge curve become horizontal if the rate of modulation envelope during negative half cycle of the modulation voltage is faster than the rate of voltage RC combination ,the output fails to follow the modulation resulting distorted output is called as diagonal clipping: this will occur even high modulation index. The depth of modulation at the detector output greater than unity and circuit impedance is less than circuit load results in clipping of negative peaks of modulating signal. It is called “negative clipping”.

PROCEDURE:

AMPLITUDE MODULATION

1. The circuit connection is made as shown in the circuit.
2. The power supply is connected to the trainer kit.
3. Set the amplitude and frequency of message sinusoidal signal.
4. Set the amplitude and frequency of carrier sinusoidal signal.
5. The Amplitude Modulated Output can be seen on DSO.
6. Calculate A_{max} and A_{min} from the Output waveform.
7. Calculate modulation index using the formula.

$$\text{Modulation index}\,(\text{m})\% = \frac{A_{max} - A_{min}}{A_{max} + A_{min}} \times 100\%$$

8. Take the print of the graph of message , carrier and amplitude modulated signal.

AMPLITUDE DEMODULATION

1. The circuit connections are made as shown in the circuit diagram.
2. The amplitude modulated signal from AM generator is given as input to the demodulator circuit.
3. The demodulated output is observed on the DSO.
4. Take the print of the graph of AM demodulated output waveform.

BLOCK DIAGRAM/ CIRCUIT DIAGRAM:

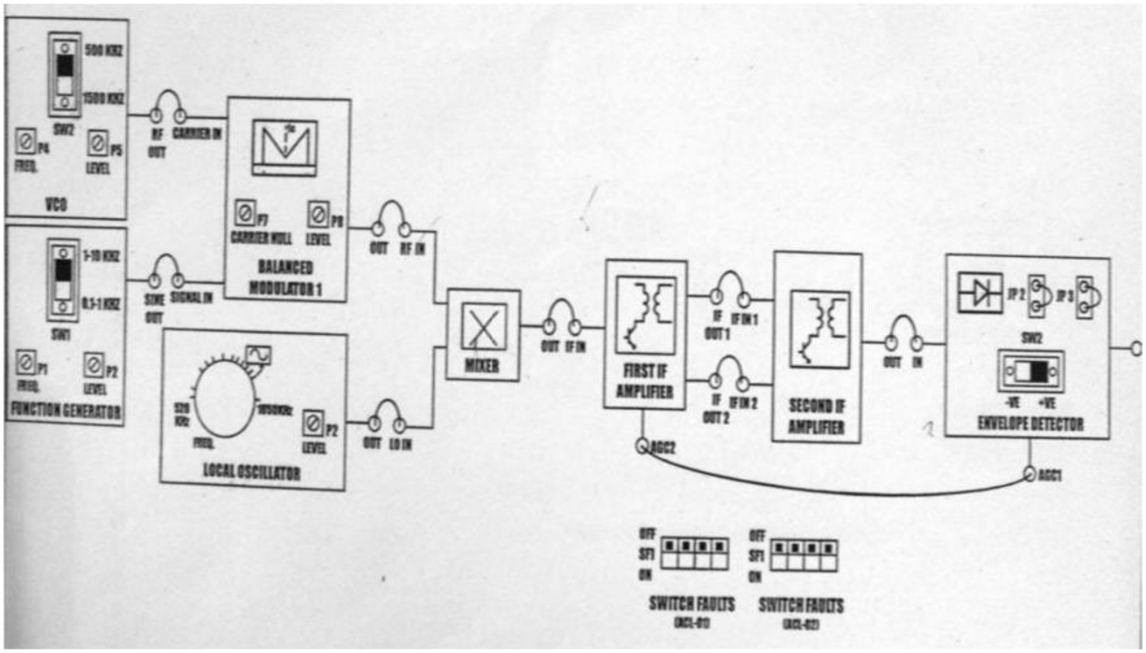
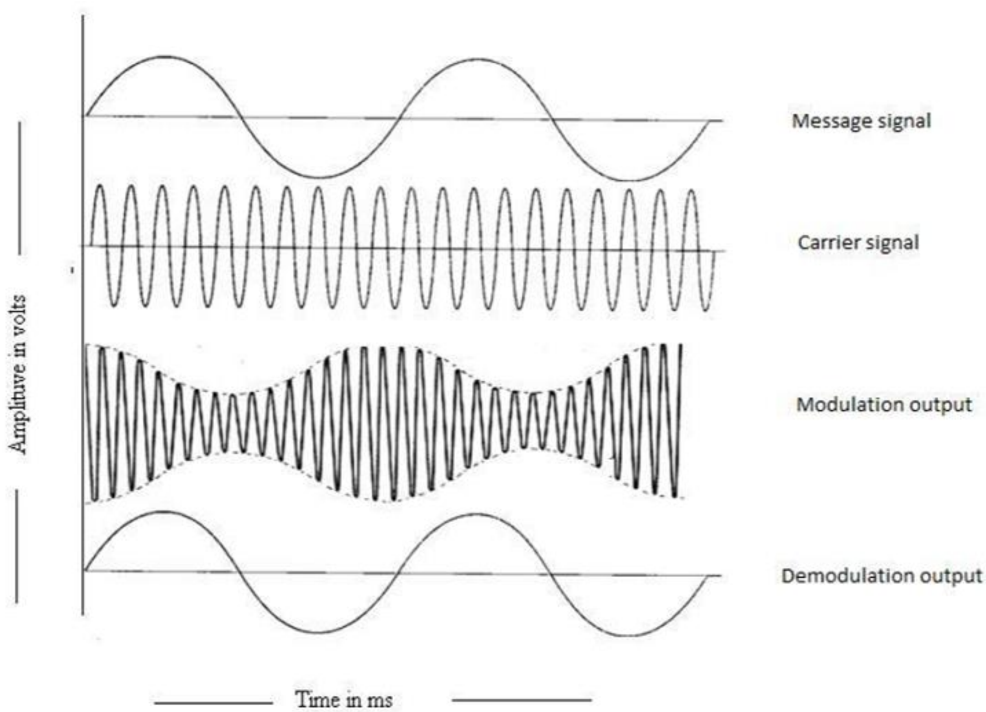


Fig3.1:Block diagram of amplitude modulation and demodulation

GRAPH:



OBSERVATION:

Modulation:

Modulating signal				Carrier signal			
Signal Type	**Time Period**	**Frequency**	**Amplitude**	**Signal Type**	**Time Period**	**Frequency**	**Amplitude**
Sine Wave				Sine Wave			
Modulated Output							
Signal Type	A_{min}		A_{max}		**Modulation index**		
AM							

Demodulation:

Demodulated Output			
Signal Type	**Time Period**	**Frequency**	**Amplitude**
Sine Wave			

RESULTS:
Thus the amplitude modulation and demodulation were performed and the modulation index for various modulating voltage were calculated.

CONCLUSION:

From the above experiment, we obtain the modulating index value =……

PRECAUTIONS:

5. Do not use open ended wires to connect 230V, 50Hz power supply.
6. Check the connection before giving the power supply.
7. Observations should be done carefully.
8. Disconnect the circuit after switched off the power supply.

EXPERIMENT No.-4

TITLE: Generation and detection of DSB-SC signal.

AIM OF THE EXPERIMENT: To analyse the generation and detection of DSB-SC Modulated signal.

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	DSB- SC trainer kit		1
2.	Digital storage oscilloscope	100MHz,1GSa/S	1
3.	Patch cord		
4.	Connecting wires		As per requirment

THEORY:

In AM, there is a carrier and two side bands. The carrier itself does not carry any information. If the carrier is 100 % modulated by a signal, each side band is one fourth of the carrier’s power. If receiver uses only one sideband, it is only one sixth of the total power radiated by the transmitter. One way to improve the AM transmitter’s efficiency is to use a technique called as suppressed carrier modulation. Balance modulator is an AM modulator in which carrier and modulating signal are introduced in such a way that the output contains the two sidebands without the carrier, that is double side band suppressed carrier (DSB-SC) AM.

PROCEDURE:

Modulation:

1. The circuit connection is made as shown in the circuit.
2. The power supply is connected to the trainer kit.
3. Set the amplitude and frequency of message sinusoidal signal as 0.5 V_{P-P} and 5 KHz respectively.
4. Set the amplitude and frequency of carrier sinusoidal signal as 1V_{P-P} and 100 KHz respectively.
5. Observe DSB-SC waveform on DSO.
6. Take the graph of DSB-SC modulated output waveform on the trace paper.

Demodulation:

1. The circuit connection is made as shown in the circuit.
2. The DSB-SC signal fromDSB-SC generator is given as input to the demodulator circuit.
3. The demodulated output is observed on the DSO.
4. Observe DSB-SC demodulated output waveform
5. Take the graph of DSB-SC demodulated output waveform on the trace paper.

BLOCK DIAGRAM:

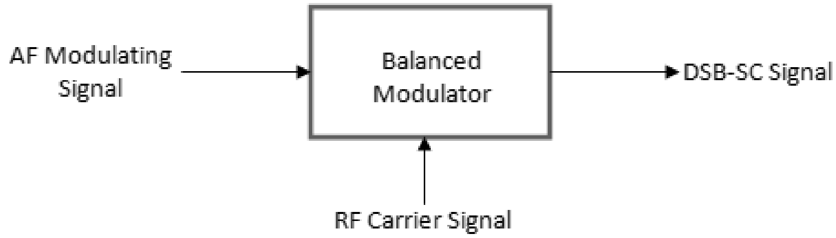


Fig4.1: Block diagram of DSB-SC modulation

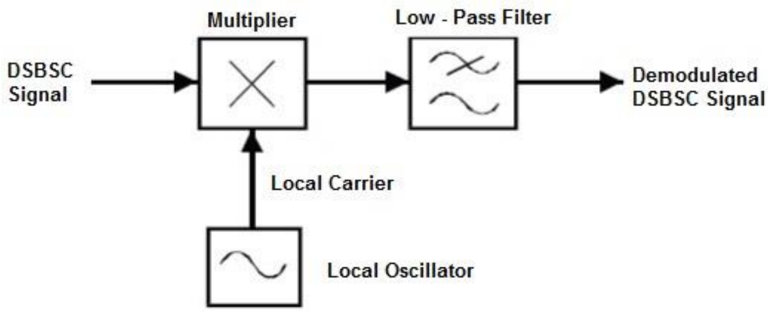
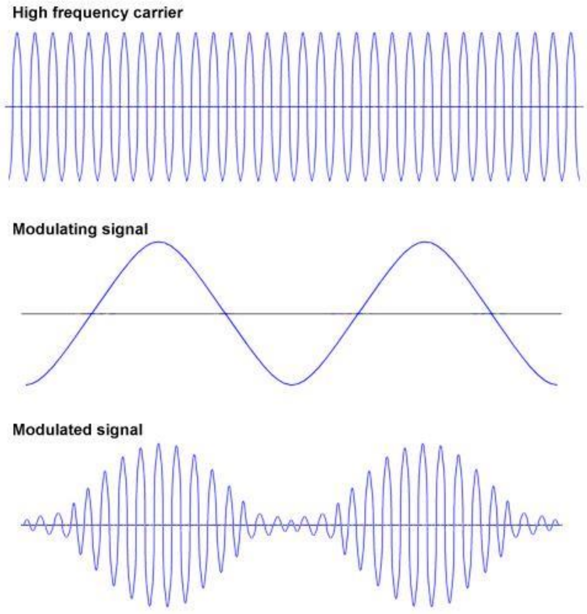


Fig4.2: Block diagram of DSB-SC demodulation

GRAPH:



OBSERVATION:

Signal	Amplitude(Volts)	Frequency(KHz)
Message Signal		
Carrier Signal		
DSB-SC signal		

RESULTS: The DSB-SC amplitude modulation and demodulation were performed successfully and waveforms were obtained.

CONCLUSION: From the above experiment, we obtain the amplitude of demodulated signal is……..

PRECAUTIONS:

9. Do not use open ended wires to connect 230V, 50Hz power supply.
10. Check the connection before giving the power supply.
11. Observations should be done carefully.
12. Disconnect the circuit after switched off the power supply.

EXPERIMENT No.-5

TITLE: Generation and detection of SSB-SC signal.

AIM OF THE EXPERIMENT: To analyse the generation and detection of SSB-SC Modulated signal.

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	SSB- SC trainer kit		1
2.	Digital storage oscilloscope	100MHz,1GSa/S	1
3.	Patch cord		
4.	Connecting wires		As per requirment

THEORY:

An SSB signal is produced by passing the DSB signal through a highly selective band pass filter. This filter selects either the upper or the lower sideband. Hence transmission bandwidth can be cut by half if one sideband is entirely suppressed. This leads to single-sideband modulation (SSB). In SSB modulation bandwidth saving is accompanied by a considerable increase in equipment complexity.

PROCEDURE:

Modulation:

1. The circuit connection is made as shown in the circuit.
2. The power supply is connected to the trainer kit.
3. Set the amplitude and frequency of message sinusoidal signal as 0.5 V_{P-P} and 5 KHz respectively.
4. Set the amplitude and frequency of carrier sinusoidal signal as 1V_{P-P} and 100 KHz respectively.
5. Observe SSB-SC waveform on DSO.
6. Take the graph of SSB-SC modulated output waveform on the trace paper.

Demodulation:

The circuit connection is made as shown in the circuit.

1. The SSB-SC signal from SSB-SC generator is given as input to the demodulator circuit.
2. The demodulated output is observed on the DSO.
3. Observe SSB-SC demodulated output waveform.
4. Take the graph of SSB-SC demodulated output waveform on the trace paper.

BLOCK DIAGRAM:

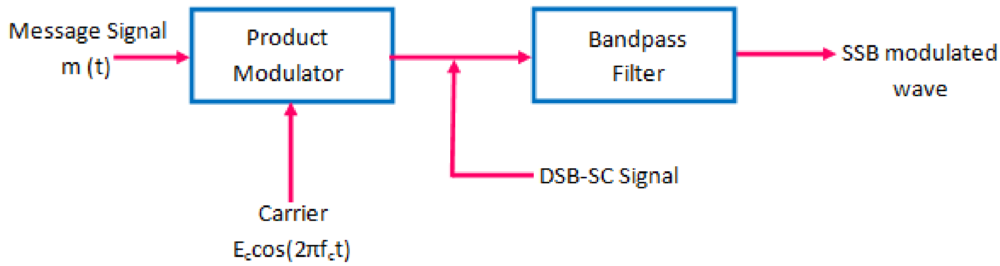


Fig5.1:Block diagram of SSB-SC modulation

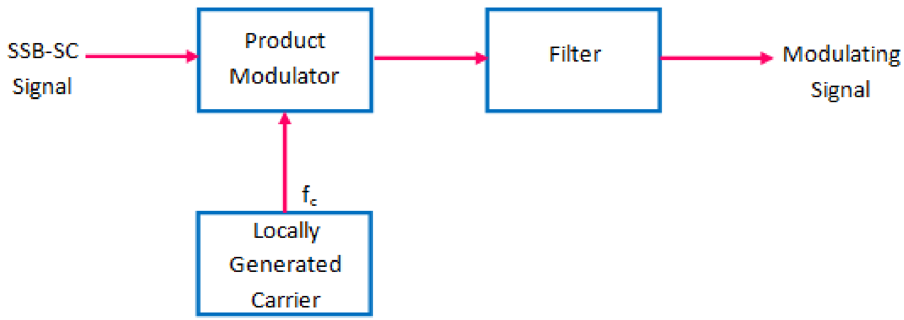
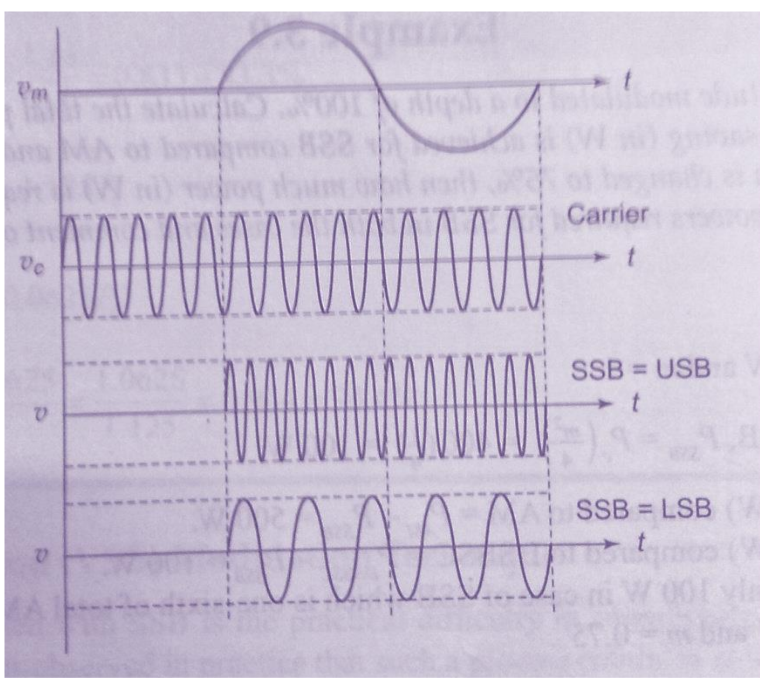


Fig5.2:Block diagram of SSB-SC demodulation

GRAPH:



OBSERVATION:

Signal	Amplitude(Volts)	Frequency(KHz)
Message Signal		
Carrier Signal		
SSB-SC signal(USB)		
SSB-SC signal(LSB)		

RESULT: The SSB-SC amplitude modulation and demodulation were performed successfully and waveforms were obtained.

CONCLUSION: From the above experiment, we obtain the amplitude of demodulated signal is……..

PRECAUTIONS:

13. Do not use open ended wires to connect 230V, 50Hz power supply.
14. Check the connection before giving the power supply.
15. Observations should be done carefully.
16. Disconnect the circuit after switched off the power supply.

<u>**EXPERIMENT No.-6**</u>

TITLE: Generation and detection of FM Modulated signal

AIM OF THE EXPERIMENT: To study the generation and detection of FM Modulated signal.

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	FM transmitter and receiver kit		1
2.	Digital Storage Oscilloscope (DSO)		1
3.	Power supply		1
4.	Patch cords		As per req.

THEORY: The process, in which the frequency of the carrier is varied in accordance with the instantaneous amplitude of the modulating signal, is called "Frequency Modulation". The FM signal is expressed as

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

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

PROCEDURE:

1. The connections are given as per the block diagram.
2. Without input signal, note down the time period Tc of the output signal.
3. Set the input signal fm as 5 KHz and 1volt sinusoidal signal.
4. Observe the FM output waveform.
5. Note down the Tmin and Tmax from the output FM waveform.
6. Calculate fmax=1/Tmin and fmin= 1/Tmax.
7. Calculate frequency deviation Δf= (fmax-fmin)/2
8. Calculate modulation index m=Δf/fm
9. Take the print of the graph all waveforms.

BLOCK DIAGRAM:

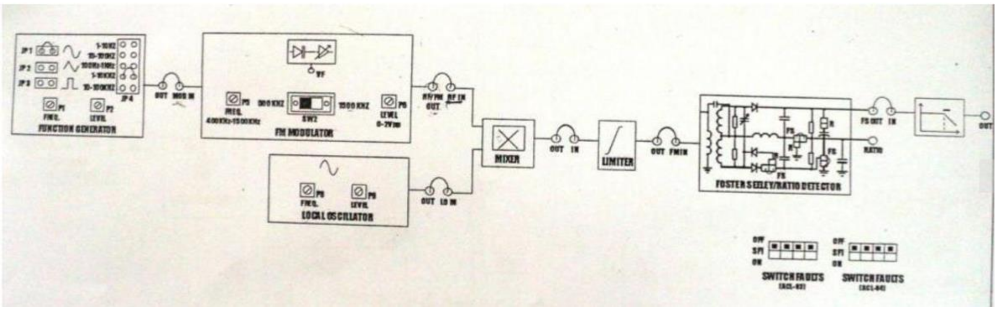
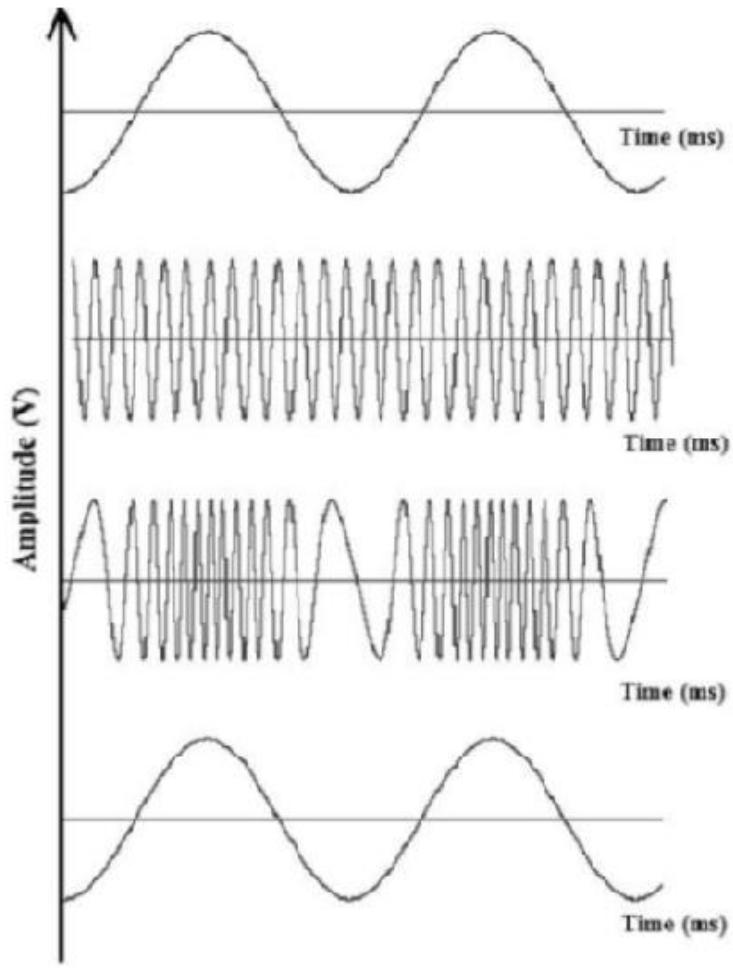


Fig3.1: Block diagram of FM modulation and demodulation

GRAPH:



OBSERVATION:

Without input signal,

T_C =………… and f_C =………………

With input signal,

Amplitude	T_{min}	f_{max}	T_{max}	f_{min}	Frequency deviation, Δf	modulation index, β

RESULTS: Frequency Modulation and Demodulation are verified in the kit and its waveforms are analysed.

CONCLUSION: From the above experiment, we obtain the modulating index value =……

PRECAUTIONS:

17. Do not use open ended wires to connect 230V, 50Hz power supply.
18. Check the connection before giving the power supply.
19. Observations should be done carefully.
20. Disconnect the circuit after switched off the power supply.

EXPERIMENT No.-7

TITLE: Generation and detection of PAM.

AIM OF THE EXPERIMENT: To study the generation and detection of Pulse Amplitude Modulation (PAM).

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	PAM modulation and Demodulation trainer kit		1
2.	Digital Storage Oscilloscope (DSO		1
3.	Power Supply		1
4.	Patch cord		
5.	Connecting Wires		As per req

THEORY:

In PAM the amplitude of the individual pulses are varied according to the amplitude of the modulating signals. The PAM modulator and demodulator circuits are simple compared to other kind of modulation and demodulation techniques. There are two kinds of PAM one in which the pulses have the same polarity and the other in which the pulses can have both positive and negative polarity according to the amplitude of the modulating signal.

Pulse amplitude modulation is a scheme, which alters the amplitude of regularly spaced rectangular pulses in accordance with the instantaneous values of a continuous message signal.

A train of very short pulses of constant amplitude and fast repetition rate is chosen, the amplitude of these pulse is made to vary in accordance with that of a slower modulating signal the result is that of multiplying the train by the modulating signal the envelope of the pulse height corresponds to the modulating wave.

The demodulated PAM waves, the signal is passed through a low pass filter having a cut –off frequency equal to the highest frequency in the modulating signal. At the output of the filter is available the modulating signal along with the DC component.

PROCEDURE:

MODULATION:

1. Connect the circuit as shown in circuit diagram.
2. Set the Carrier square wave of 3Vpp at 10 KHz.
3. Set the modulating signal of 1.5Vpp, 500 Hz.
4. Observe the PAM modulated output wave on DSO.
5. Plot the graph of the modulating signal, Carrier signal and PAM modulated waveforms.

DEMODULATION:

1. Connect modulator circuit output to RC filter circuit (LPF).
2. Measure the amplitude and frequency of the demodulated signal from the DSO and verify with that of the modulating input .
3. Plot the demodulated waveform.

BLOCK DIAGRAM:

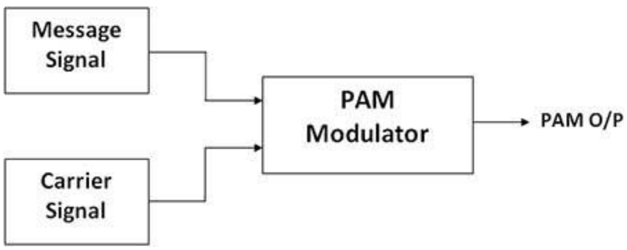


Fig7.1: Block diagram of PAM Modulation

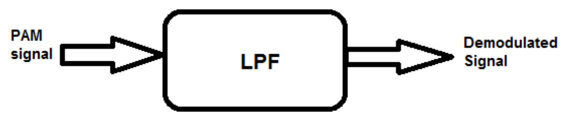
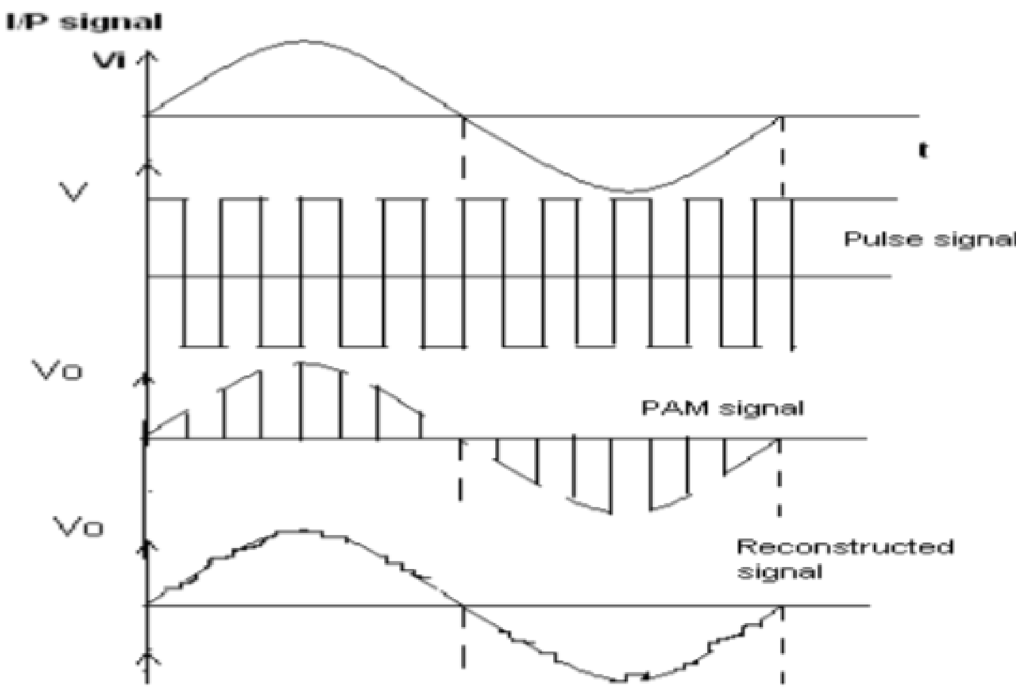


Fig7.2:Block diagram of PAM Demodulation

GRAPH:



OBSERVATION:

Modulation:

Modulating signal				Carrier signal			
Signal Type	**Time Period**	**Frequency**	**Amplitude**	**Signal Type**	**Time Period**	**Frequency**	**Amplitude**
Sine Wave				Square Wave			

Modulated Output			
Signal Type	**A_{min}**	**A_{max}**	**Modulation index**
PAM			

Demodulation:

Demodulated Output			
Signal Type	**Time Period**	**Frequency**	**Amplitude**
Sine Wave			

RESULTS:
Thus the pulse amplitude modulation and demodulation was performed and its corresponding waveforms are plotted.

CONCLUSION: From the above experiment, we got the value of

Pulse amplitude modulated output voltage=………

Reconstructed output voltage=………

PRECAUTIONS:

1. Do not use open ended wires to connect 230V, 50Hz power supply.
2. Check the connection before giving the power supply.
3. Observations should be done carefully.
4. Disconnect the circuit after switched off the power supply.

EXPERIMENT No.-8

TITLE: Generation and detection of PWM.

AIM OF THE EXPERIMENT: To study the generation and detection of Pulse Width Modulation (PWM).

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	PWM modulation and Demodulation trainer kit		1
2.	Digital Storage Oscilloscope (DSO		1
3.	Power Supply		1
4.	Patch cord		
5.	Connecting Wires		As per req

THEORY:

Pulse Time Modulation is also known as Pulse Width Modulation or Pulse Length Modulation. In PWM, the samples of the message signal are used to vary the duration of the individual pulses. Width may be varied by varying the time of occurrence of leading edge, the trailing edge or both edges of the pulse in accordance with modulating wave. The PWM has the disadvantage that its pulses are of varying width and therefore of varying power content, this means the transmitter must be powerful enough to handle the max width pulses.

PROCEDURE:

MODULATION:

1. Connect the circuit as shown in circuit diagram.
2. Set the Carrier square wave of 3Vpp at 10 KHz.
3. Set the modulating signal of 1.5Vpp, 1 KHz.
4. Observe the PWM modulated output wave on DSO.
5. Plot the graph of the modulating signal, Carrier signal and PWM modulated waveforms.

DEMODULATION:

1. Connect modulator circuit output to input of demodulated block of PWM demodulator.
2. Measure the amplitude and frequency of the demodulated signal from the DSO and verify with that of the modulating input.
3. Plot the demodulated waveform.

BLOCK DIAGRAM:

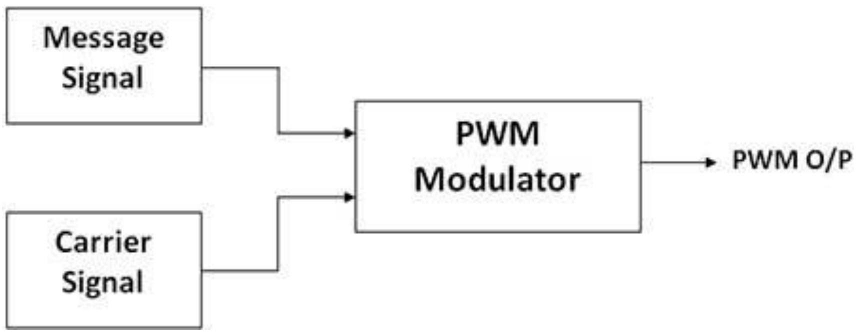


Fig8.1: Block diagram of PWM Modulation

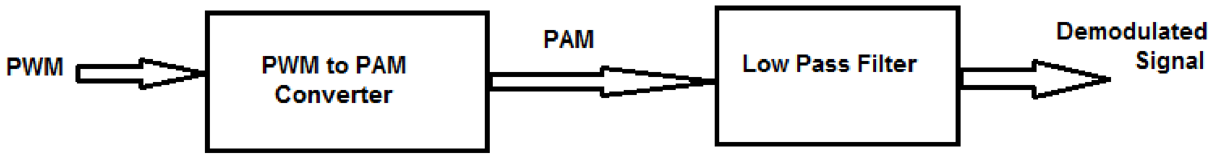
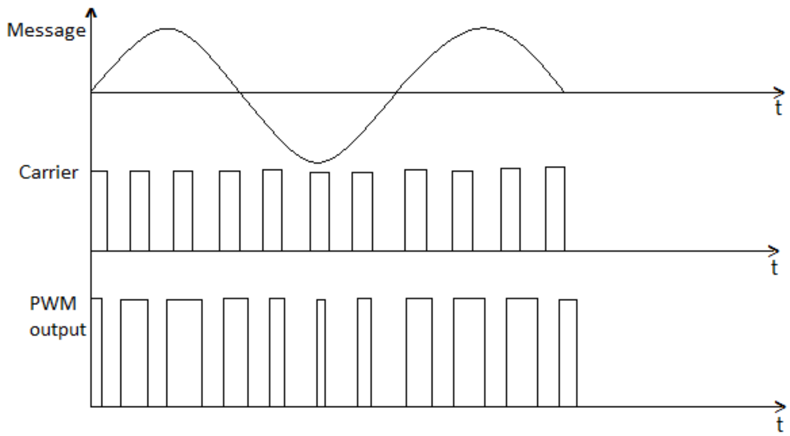


Fig8.2: Block diagram of PWM Modulation

GRAPH:



OBSERVATION:

S.No.	Control Voltage	Output Pulse Width(msec)

RESULTS: The PWM circuit diagrams were set up and waveforms were verified.

CONCLUSION:

From the above experiment, the maximum width of PWM signal is……… at control voltage of …………

PRECAUTIONS:

1. Do not use open ended wires to connect 230V, 50Hz power supply.
2. Check the connection before giving the power supply.
3. Observations should be done carefully.
4. Disconnect the circuit after switched off the power supply.

EXPERIMENT No.-9

TITLE: Generation and detection of PPM.

AIM OF THE EXPERIMENT: To study the generation and detection of Pulse Position Modulation (PPM).

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	PPM modulation and Demodulation trainer kit		1
2.	Digital Storage Oscilloscope (DSO		1
3.	Power Supply		1
4.	Patch cord		
5.	Connecting Wires		As per req

THEORY:

In this type of modulation, the amplifier and width of the pulses is kept constant while the position of each pulse with reference to the position of a reference pulse is changed according to the instantaneous sampled value of the modulating signal. It can be obtained by differentiating the PWM signal. It can also be obtained by feeding the PWM signal to the mono-stable multivibrator.

PROCEDURE:

MODULATION:

1. Connect the circuit as shown in circuit diagram.
2. Set the Carrier square wave of 3Vpp at 10 KHz.
3. Set the modulating signal of 1.5Vpp, 1 KHz.
4. Observe the PPM modulated output wave on DSO.
5. Plot the graph of the modulating signal, Carrier signal and PWM modulated waveforms.

DEMODULATION:

1. Connect modulator circuit output to input of demodulated block of PPM demodulator.
2. Measure the amplitude and frequency of the demodulated signal from the DSO and verify with that of the modulating input.
3. Plot the demodulated waveform.

BLOCK DIAGRAM:

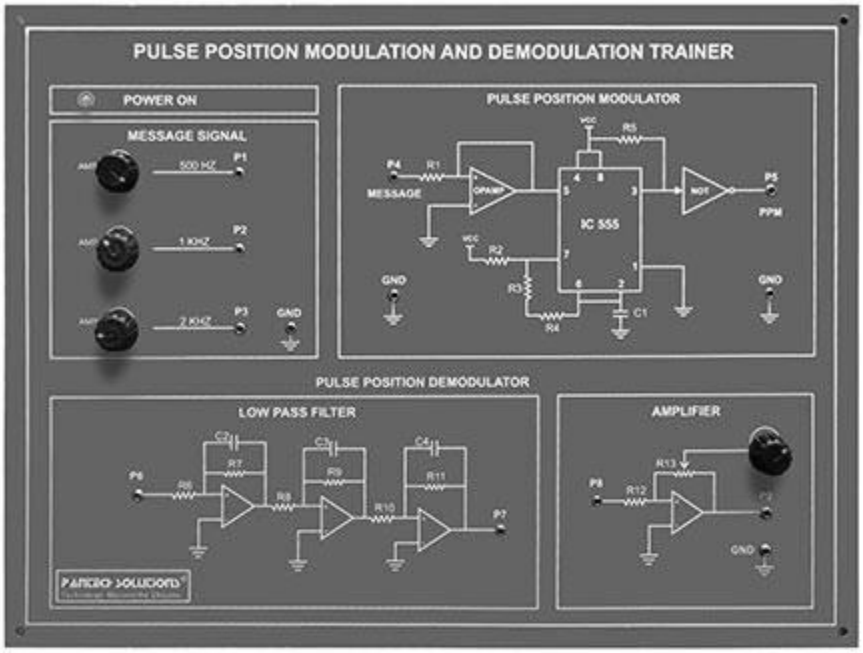
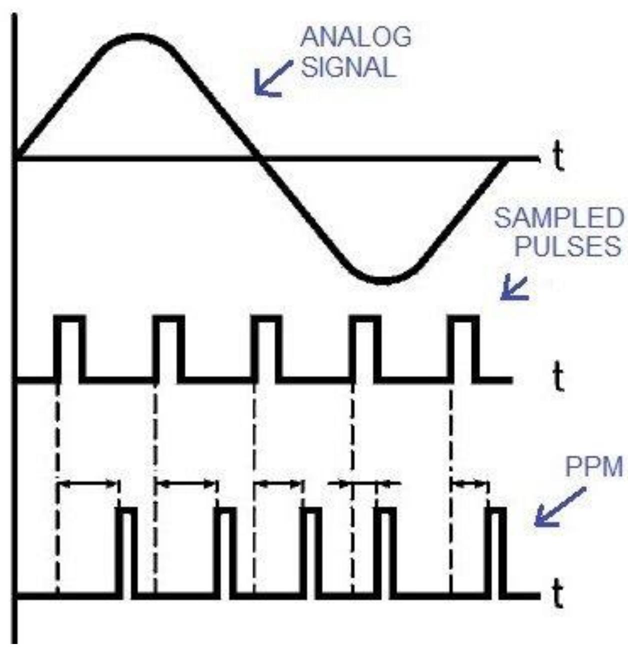


Fig9.1: Block diagram of PPM modulation and demodulation

GRAPH:



OBSERVATION:

S.No.	Control Voltage	Pulse position difference(msec)

RESULTS: The PPM circuit diagrams were set up and waveforms were verified.

CONCLUSION:

From the above experiment, the maximum position difference of PPM signal from its actual point is……… at control voltage of …………

PRECAUTIONS:

1. Do not use open ended wires to connect 230V, 50Hz power supply.
2. Check the connection before giving the power supply.
3. Observations should be done carefully.
4. Disconnect the circuit after switched off the power supply.

EXPERIMENT No.-10

TITLE: AM Superhetrodyne receiver.

AIM OF THE EXPERIMENT: To Study the AM Superhetrodyne receiver.

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	AM superhetrodyne receiver kit		1
2.	Power supply		1
3.	Connecting wire		As per req.
4.	Digital Storage Oscilloscope		1
5.	Spectrum Analyzer		1
6.	Patch cord		

THEORY:

The block diagram of a basic superheterodyne receiver is illustrated in Figure10.1. In a typical broadcast radio receiver, the input to the RF amplifier is obtained from the antenna tuning circuit as the station selector dial changes the capacitance and therefore the resonant frequency of the LC tank circuit. The local oscillator frequency is adjusted simultaneously by varying a tuning capacitor that is also connected to the station selector dial. The local oscillator frequency is designed to change so that it is always a fixed value above the selected station frequency. Thus, if the RF tuner is centred at a frequency f_C , then

$$f_{LO} = f_C + f_{IF}$$

where f_{IF} is the amount that the local oscillator is above the carrier frequency selected. In most AM broadcast band radio receivers f_{IF} = 455 KHz, and in most FM receivers f_{IF} =10.7MHz. With the latest all digitally tuned radio receivers the basic techniques discussed above still apply. The RF amplifier can be tuned using an LC tank circuit with the capacitance component being a varactor diode which provides a voltage controlled capacitance, and hence a voltage controlled resonant frequency. The local oscillator frequency can be obtained from a digitally programmable frequency synthesizer. The tuning voltage which drives the voltage controlled oscillator of the frequency synthesizer can also be used to tune the RF amplifier. In any case a digital word which corresponds to the desired station frequency can be used to set both the local oscillator and the RF amplifier centre frequency.

PROCEDURE:

To simulate a superheterodyne receiver, you will need to construct the circuit shown in Figure10.1

1. Adjust the local oscillator (LO) sine wave source to about 500mv peak-to-peak with a frequency of 955 KHz. With the Agilent synthesized sources getting the precise LO frequency needed to down-convert the RF signal, should be easy.

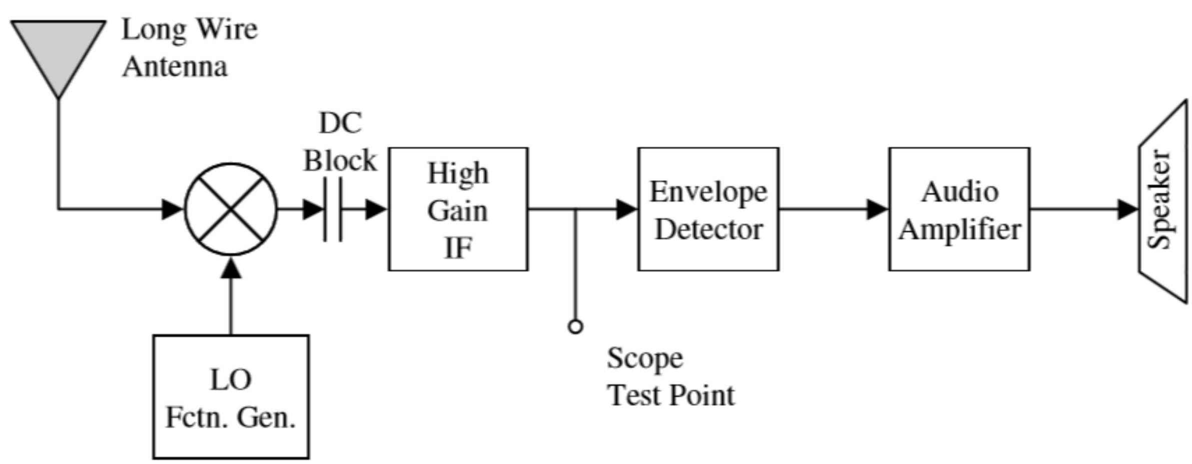
2. Adjust the AM modulator and/or function generators to obtain a 50% modulated 500 kHz carrier at a level that will not cause distortion in the mixer output. Be sure to balance the receiver mixer.

3. Adjust the LO frequency slightly to obtain a maximum output from the IF filter. When you have the maximum, accurately measure the frequency of each of the signal sources into the mixer and calculate the centre frequency of the filter. When measuring the frequency of the modulated carrier, measure it with 50% modulation applied to it. Use the frequency counter to measure the carrier frequency. Do you know why the frequency counter can accurately measure a50% modulated waveform?

4. With the oscilloscope triggered by the 5000Hz modulation source, observe the input and output of the IF filter. Note that the envelope, or modulation, is the same for either signal. The output, however, should be a clean and undistorted modulated carrier at the IF. With the output of the filter at a maximum, adjust the frequency control on the 5000Hz source until you can clearly see the IF carrier waveform and thereby verify that the double frequency component is suppressed by the filter. Note: the modulation index of the AM signal at the output of the IF filter will change depending upon how the carrier and/or local oscillator frequencies are adjusted. This is due to the fact that the 5000Hz message sidebands get attenuated due to the narrow bandwidth of the IF filter.

5. Using a spectrum analyzer connected to the input and then to the output of the mixer and filter, identify all the frequencies components of the superheterodyne system you have constructed. Make a sketch of the spectrum at each of the locations you check.

BLOCK DIAGRAM:



RESULT: The AM superhetrodyne receiver was studied successfully.

PRECAUTIONS:

1. Do not use open ended wires to connect 230V, 50Hz power supply.
2. Check the connection before giving the power supply.
3. Observations should be done carefully.
4. Disconnect the circuit after switched off the power supply.