LAB MANUAL

EC205PPC07

Analog and Digital Communication Lab

Bachelor of Technology

in

Electronics & Communication Engineering

Department of Electronics & Communication Engineering

School of Studies of Engineering & Technology

Guru Ghasidas Vishwavidyalaya

Bilaspur-495009 (C. G.)

Website: www.ggu.ac.in

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)

(A CENTRAL UNIVERSITY)

CBCS-NEW SYLLABUS

B. TECH. THIRD YEAR (Electronics and Communication Engineering)

Vision and Mission of the Institute

Vision		To be a leading technological institute that imparts transformative education to create globally competent technologists, entrepreneurs, researchers and leaders for a sustainable society
Mission	1	To create an ambience of teaching learning through transformative education for future leaders with professional skills, ethics, and conduct.
	2	To identify and develop sustainable research solutions for the local and global needs.
	3	To build a bridge between the academia, industry and society to promote entrepreneurial skills and spirit

Vision and Mission of the Department

Vision		The Department endeavours for academic excellence in Electronics & Communication Engineering by imparting in depth knowledge to the students, facilitating research activities and cater to the ever-changing industrial demands, global and societal needs with leadership qualities.
Mission	1	To be the epitome of academic rigour, flexible to accommodate every student and faculty for basic, current and future technologies in Electronics and Communication Engineering with professional ethics.
	2	To develop an advanced research centre for local & global needs.
	3	To mitigate the gap between academia, industry & societal needs through entrepreneurial and leadership promotion.

Program Educational Objectives (PEOs)

The graduate of the Electronics and Communication Engineering Program will

PEO1: Have fundamental and progressive knowledge along with research initiatives in the field of Electronics & Communication Engineering.

PEO2: Be capable to contrive solutions for electronic & communication systems for real world applications which are technically achievable and economically feasible leading to academia, industry, government and social benefits.

PEO3: Have performed effectively in a multi-disciplinary environment and have self-learning & self-perceptive skills for higher studies, professional career or entrepreneurial

endeavors to be confronted with a number of difficulties.

PEO4: Attain team spirit, communication skills, ethical and professional attitude for lifelong learning.

Programme Outcomes: Graduates will be able to:

PO1: **Fundamentals:** Apply knowledge of mathematics, science and engineering.

PO2: **Problem analysis**: Identify, formulate and solve real time engineering problems using first principles.

PO3: **Design:** Design engineering systems complying with public health, safety, cultural, societal and environmental considerations

PO4: **Investigation:** Investigate complex problems by analysis and interpreting the data to synthesize valid solution.

PO5: **Tools:** Predict and model by using creative techniques, skills and IT tools necessary for modern engineering practice.

PO6: **Society:** Apply the knowledge to assess societal, health, safety, legal and cultural issues for practicing engineering profession.

PO7: **Environment:** Understand the importance of the environment for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics, and responsibilities and norms of the engineering practice.

PO9: **Teamwork:** Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary settings.

PO10: **Communication:** Communicate effectively by presentations and writing reports.

PO11: **Management:** Manage projects in multidisciplinary environments as member or a team leader.

PO12: **Life-long learning:** Engage in independent lifelong learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO1: Identify, formulate and apply concepts acquired through Electronics &

Communication Engineering courses to the real-world applications.

PSO2: Design and implement products using the cutting-edge software and hardware tools to attain skills for analyzing and developing subsystem/processes.

PSO3: Ability to adapt and comprehend the technology advancement in research and contemporary industry demands with demonstration of leadership qualities and betterment of organization, environment and society.

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC205PPC07	-	-	2	2Hours	30	20	50	

ANALOG AND DIGITAL COMMUNICATION LAB

Course Objectives:

To Study the basics of analog and digital modulation techniques and get real-time and practical exposure of communication systems with detailed analysis of analog and digital communication techniques.

Course Outcomes:

At the end of the course, the students will able to:

CO1 To analyze the fundamental concepts of analog communication systems.

CO2 To perform the sampling process.

CO3Implement the various pulse modulation schemes for digital communication

CO4 Examine the performance of coding in digital systems.

CO5 Demonstrate the various digital modulation technique

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3				1			2	3	1	1
CO2	3	2	1	1	3				1			2	3	1	1
CO3	3	3	2	1	3				1			2	3	1	1
CO4	3	3	2	1	3				1			2	3	1	1
CO5	3	3	2	1	3				1			2	3	1	1

EXPERIMENT NO-1

AMPLITUDE MODULATION & DEMODULATION

AIM: (i) To study of Amplitude Modulation & Demodulation.

APPARATUS :

1. Amplitude Modulation & De modulation trainer kit.
2. C.R.O (20MHz)
3. Function generator (1MHz).
4. Connecting cords & probes.

THEORY:

Modulation is defined as the process of changing the characteristics (Amplitude, Frequency or Phase) of the carrier signal (high frequency signal) in accordance with the intensity of the message signal (modulating signal).

Amplitude modulation is defined as a system of modulation in which the amplitude of the carrier is varied in accordance with amplitude of the message signal (modulating signal).

The message signal is given by the expression.

$Em(t) = E_m \cos w_m t$

Where Wm is------ > Angular frequency

Em -------- → Amplitude

Carrier voltage $E_c(t) = E_c \cos w_c t$

$E(t) = Ec + KaEm \cos Wmt$

$K_a E_m \cos w_m t$ --------→ change in carrier amplitude

K_a ---- → constant

The amplitude modulated voltage is given by

$E = E(t) \cos w_c t$

From above two equations

$E = (Ec + KaEm \cos w_m t) \cos w_c t$

$E = (1 + KaEm/Ec \cos w_m t)\ Ec \cos w_c t$

$E = Ec(1 + Ma \cos w_m t) \cos Wct$

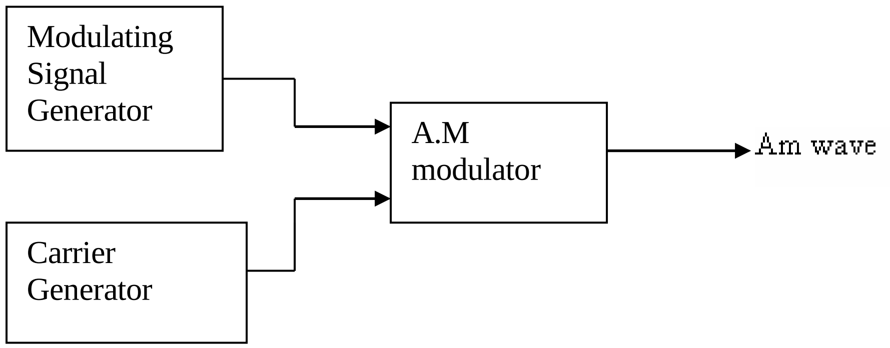
Where Ma ---- → depth of modulation/ modulation index/modulation factor

$M_a = K_a E_m / E_c$

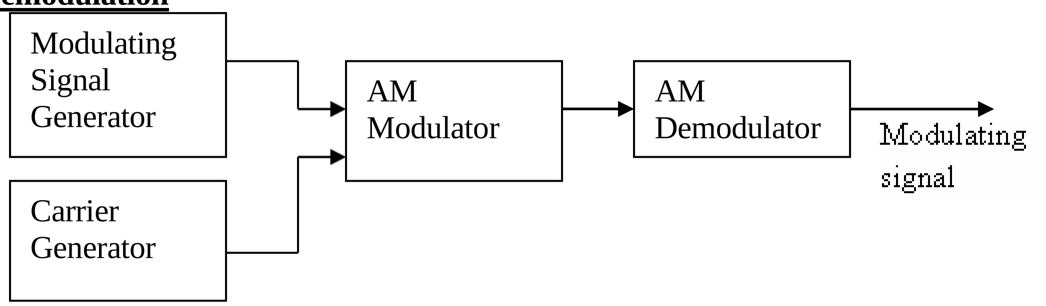
100* M_a gives the percentage of modulation.

BLOCK DIAGRAM:

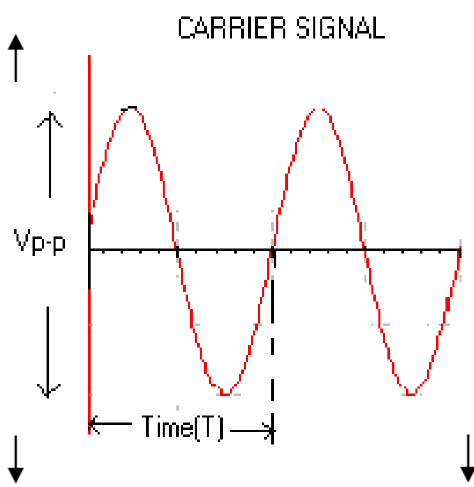
Modulation

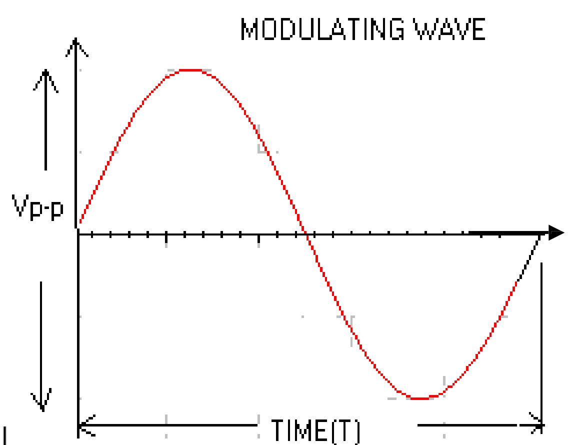


Demodulation

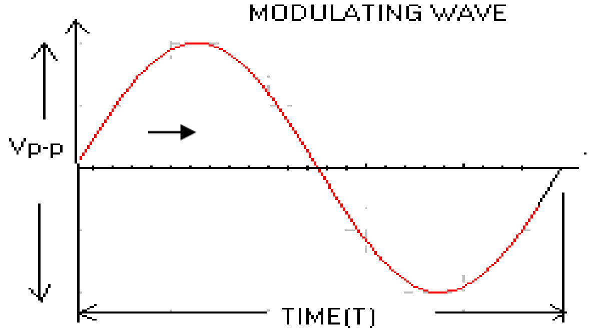


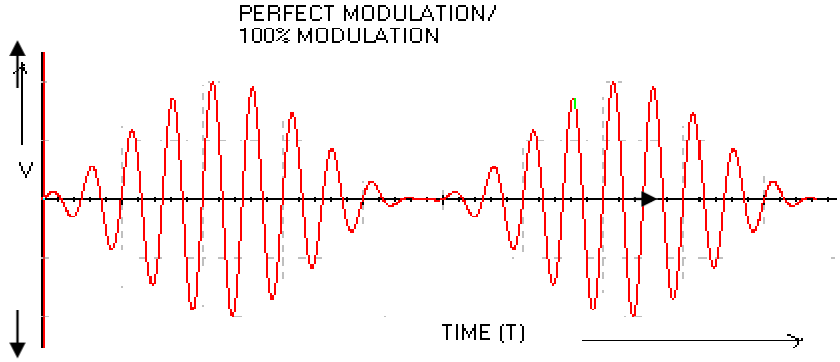
EXPECTED WAVEFORMS: -

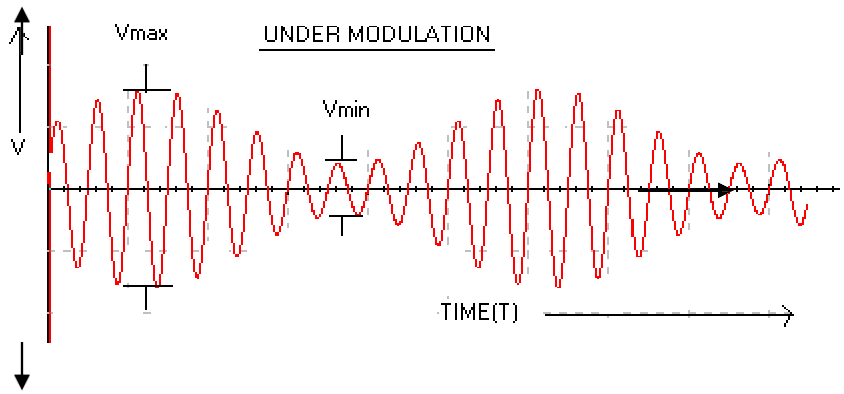


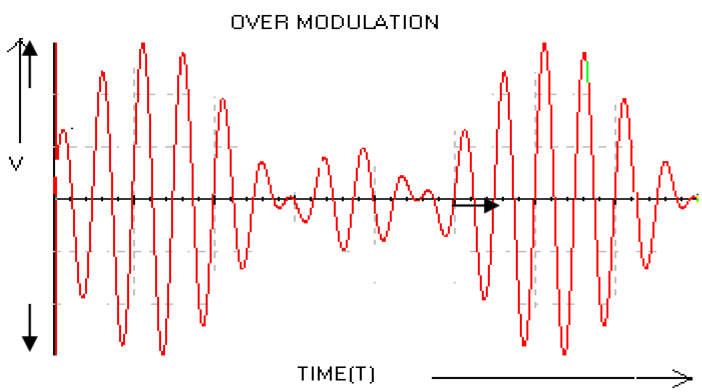


Demodulated signal









OBSERVATIONS:

Modulation

	Vc (V)	Vm (V)	Vmax (V)	Vmin (V)	m=(Vmax-Vmin)/(Vmax+Vmin)	m= Vm/Vc
Under modulation						
Perfect modulation						
Over modulation						

Demodulation

Modulating signal Frequency	Demodulated output signal frequency

RESULT:

QUESTIONS

1. Define AM and draw its spectrum?
2. Draw the phase's representation of an amplitude modulated wave?
3. Give the significance of modulation index?
4. What are the limitations of square law modulator?
5. Explain how AM wave is detected?
6. Define detection process?
7. What are the different types of distortions that occur in an envelop detector?
8. What is the condition of for over modulation?

9. Define modulation & demodulation?
10. What are the different types of linear modulation techniques?
11. Explain the working of carrier wave generator.
12. Explain the work

EXPERIMENT NO-2

DSB-SC MODULATOR & DETECTOR

AIM: To study the working of the Balanced Modulator and demodulator.

APPARATUS:

1. Balanced modulator trainer kit
2. C.R.O (20MHz)
3. Connecting cords and probes
4. Function generator (1MHz)
5. PC with windows (95/98/XP/NT/2000)
6. MATLAB Software with communication toolbox

THEORY:

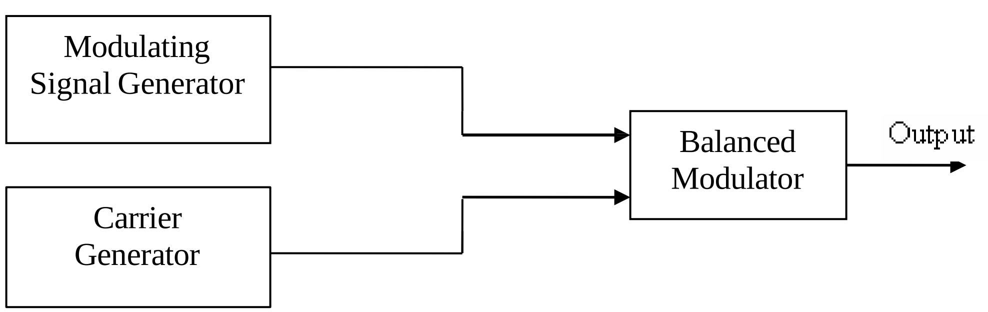
Balanced modulator circuit is used to generate only the two side bands DSB-SC. The balanced modulation system is a system is a system of adding message to carrier wave frequency there by only the side bands are produced. It consists of two AM modulators arranged in a balanced configuration. The AM modulator is assumed to be identical. The carrier input to the two modulators is same.

If we eliminate or suppress the carrier then the system becomes suppressed carrier DSB-SC. In this we need reinsert the carrier is complicated and costly. Hence the suppressed carrier DSB system may be used in point to point communication system.

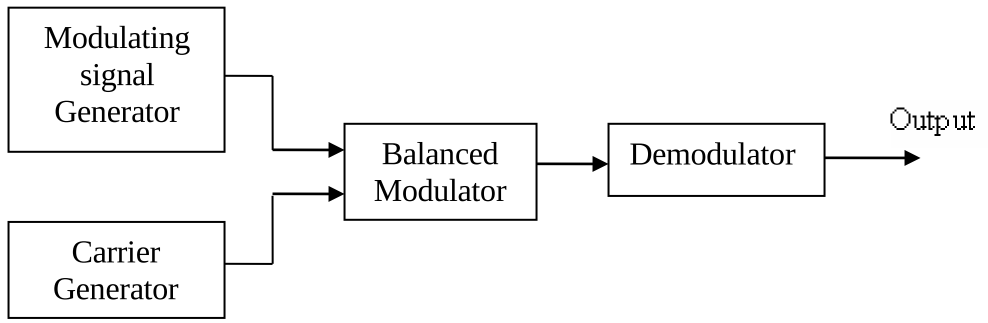
Generation of suppressed carrier amplitude modulated volt balanced modulator may be of the following types.

1. Using transistors or FET.
2. Using Diodes

BLOCK DIAGRAM: **Modulation**



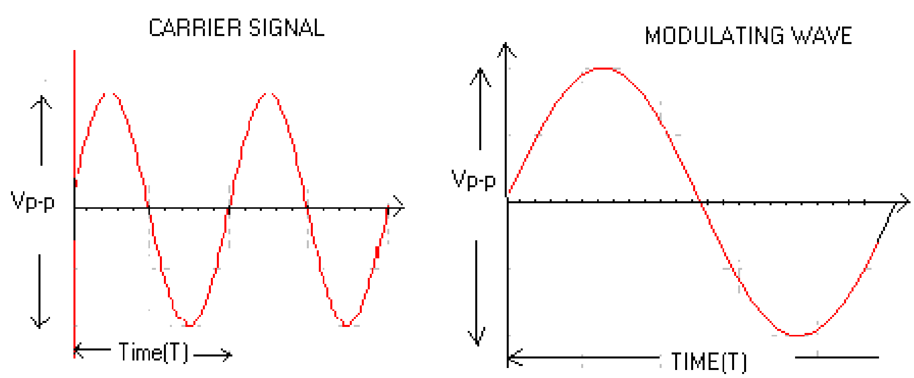
Demodulation

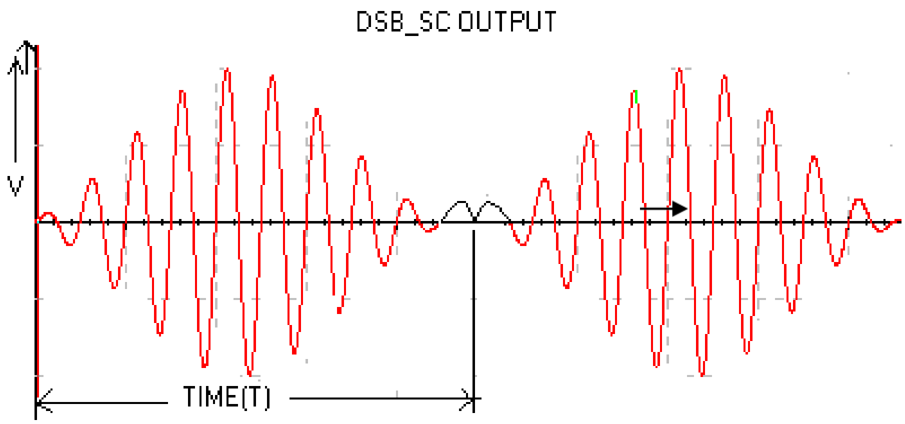


PROCEDURE:-

1. Connect the circuit as per the given circuit diagram.
2. Switch on the power to the trainer kit.
3. Apply a 100KHz, 0.1 peak sinusoidal to the carrier input and a 5KHz, 0.1 peak sinusoidal to the modulation input.
4. Measure the output signal frequency and amplitude by connecting the output to CRO.
5. And note down the output signals.

EXPECTED WAVEFORMS:-





OBSERVATIONS:

Carrier Signal		Message signal		Modulated signal		Demodulated Signal	
				output		output	
Fc(Hz)	Vc(volts)	Fm(Hz)	Vm(v)	Fo(Hz)	Vo(v)	F(Hz)	V(v)

RESULT:

QUESTIONS

1. What are the two ways of generating DSB_SC?
2. What are the applications of balanced modulator?
3. What are the advantages of suppressing the carrier?
4. What are the advantages of balanced modulator?
5. What are the advantages of Ring modulator?
6. Write the expression for the output voltage of a balanced modulator?
7. Explain the working of balanced modulator and Ring Modulator using diodes.

SSB-SC MODULATOR & DETECTOR (PHASE SHIFT METHOD)

AIM:- To generate SSB using phase method and detection of SSB signal using Synchronous detector.

APPARATUS:-

1. SSB trainer kit
2. C.R.O (20MHz)
3. Patch cards
4. CRO probes

THEORY:

AM and DSBSC modulation are wasteful of band width because they both require a transmission bandwidth which is equal to twice the message bandwidth In SSB only one side band and the carrier is used. The other side band is suppressed at the transmitter, but no information is lost. Thus the communication channel needs to provide the same band width, when only one side band is transmitted. So the modulation system is referred to as SSB system.

The base band signal may not be recovered from a SSB signal by the Use of a diode modulator. The bae band signal can be recovered if the spectral component of the output i.e either the LSB or USB is multiplied by the carrier signal.

Consider the modulating signal

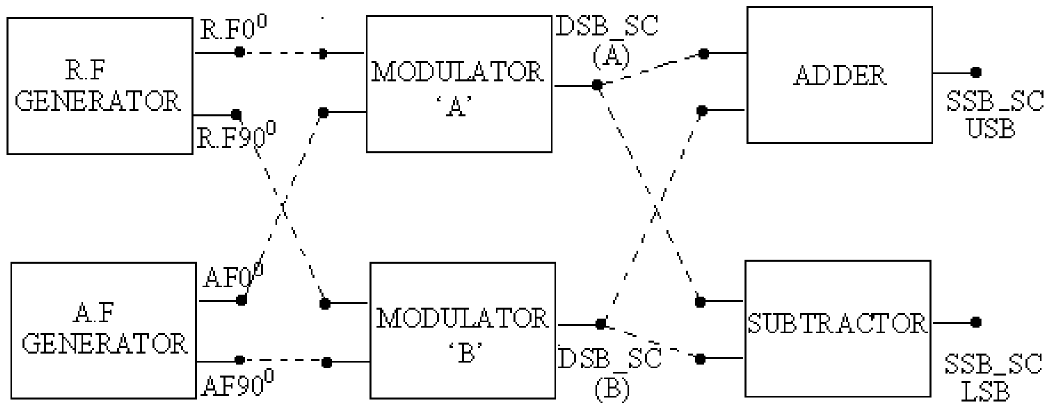
$M(t)=A_m \cos W_mt$ $C(t)=A_c \cos W_ct$

$M(t)c(t)= A_cA_m \cos W_mt \cos W_ct$

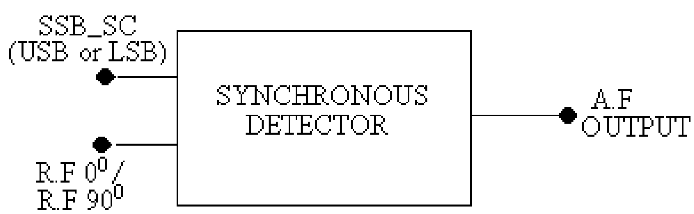
The above signal when passed through a filter, only one of the above component is obtained which lays the SSB signal.

BLOCK DIAGRAM: -

SSB MODULATION



SSB DEMODULATION/SYNCHRONOUS DETECTOR



PROCEDURE:-

SSB MODULATION

1. Connect the Adaptor to the mains and the other side to the Experimental Trainer Switch 'ON' the power.

2. (a) Connect carrier f_c 90^0 to A_{in} of Balanced Modulator –A and adjust its amplitude to 0.1Vpp.

(b). Connect modulating signal f_m 0^0 5Vpp to B_{in} of the Balanced Modulator-A.

3. Observe the DSB-A output on CRO.

4. Connect fc 0^0 at 0.1 Vpp at C_{in} of Balanced Modulator B. Connect fm 90^0 at 5 Vpp at D_{in} of Balanced Modulator B.

5. Connect the DSB-A output and DSB-B output to the summing amplifier. Observe the output (SSB output) on the spectrum analyzer. This gives single side band (upper) only while the lower side band is cancelled in the summing Amplifier.

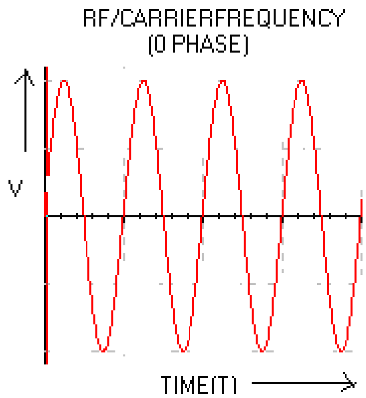
SSB DEMODULATION

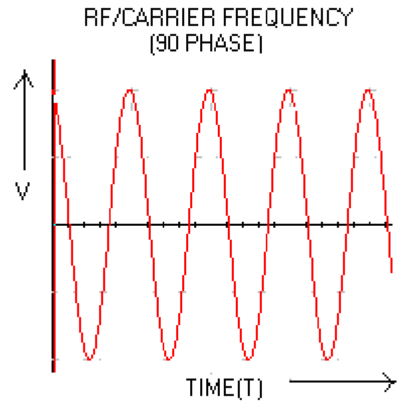
1. Connect the carrier fc 0^0 and SSB output to the synchronous detector.
2. Connect the demodulator output on the oscilloscope which is the recovered modulating signal.

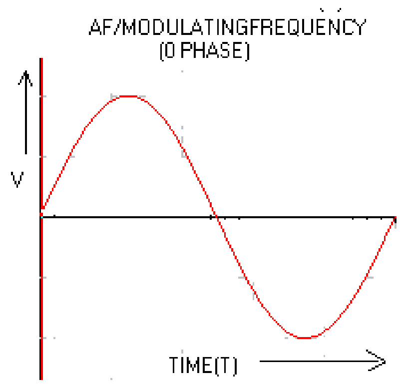
OBSERVATIONS:

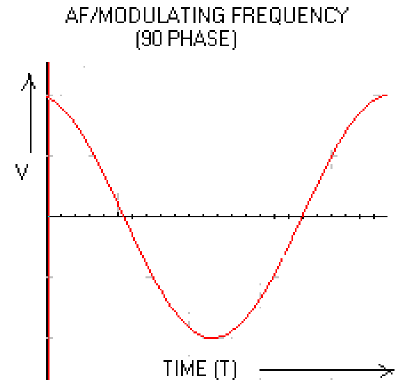
Carrier signal		Modulating signal		Balanced modulator -A		Balanced modulator -B		Adder/ Subtractor Output		Synchronous detector	
Fc	**Vc**	**Fm**	**Vm**	**Vmax**	**Vmin**	**Vmax**	**Vmin**	**Vmax**	**Vmin**	**Fd**	**Vd**

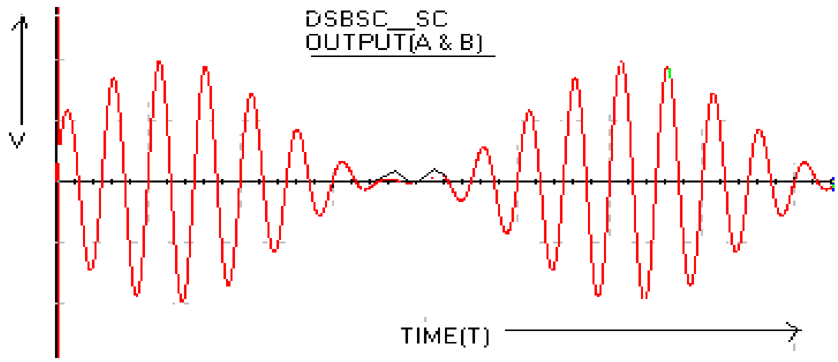
EXPECTED WAVE FORMS: -

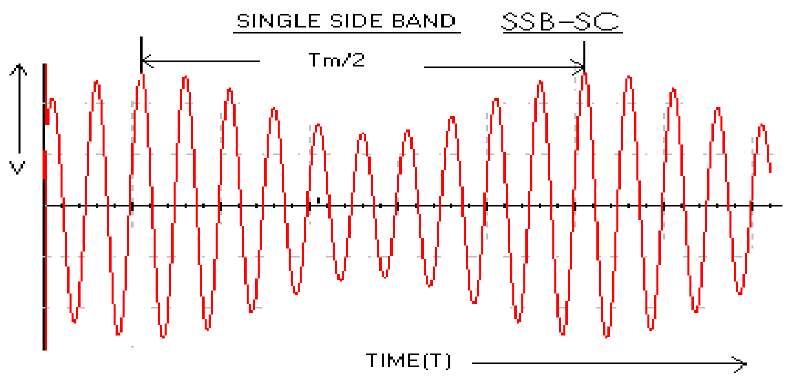




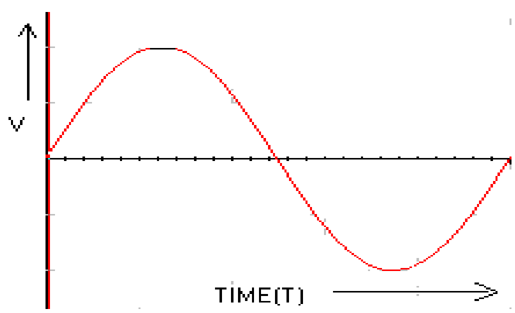








SSB DEMODULATED OUTPUT



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RESULT:

QUESTIONS:

1. **What are the different methods to generate SSB-SC signal?**

2. What is the advantage of SSB-SC over DSB-SC?

3. Explain Phase Shift method for SSB generation.

4. Why SSB is not used for broadcasting?

SSB DETECTION

5. Give the circuit for synchronous detector?

6. What are the uses of synchronous or coherent detector?

7. Give the block diagram of synchronous detector?

8. Why the name synchronous detector.

EXPERIMENT NO. 3

FREQUENCY MODULATION AND DEMODULATION

AIM: To study of frequency modulation and demodulation.

APPARATUS :

1. FM modulation and demodulation kit
2. Dual trace CRO.
3. CRO probes
4. Patch cards.

THEORY:

The modulation system in which the modulator output is of constant amplitude, in which the signal information is super imposed on the carrier through variations of the carrier frequency.

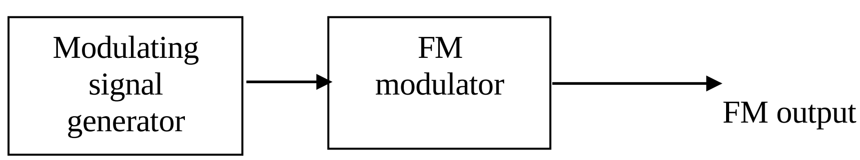
The frequency modulation is a non-linear modulation process. Each spectral component of the base band signal gives rise to one or two spectral components in the modulated signal. These components are separated from the carrier by a frequency difference equal to the frequency of base band component. Most importantly the nature of the modulators is such that the spectral components which produce decently on the carrier frquency and the base band frequencies.The spetral components in the modulated wave form depend on the amplitude.

The modulation index for FM is defined as

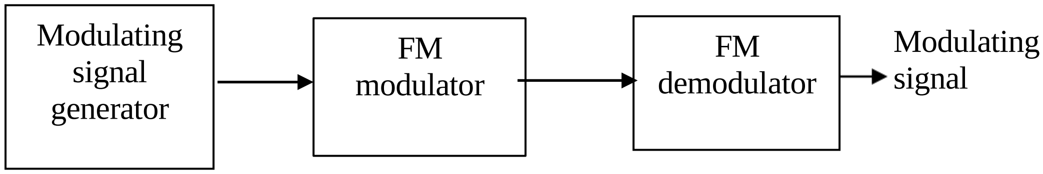
Mf= max frequency deviation/ modulating frequency.

BLOCK DIAGRAM:

Modulation



Demodulation



PROCEDURE:

1. Switch on the experimental board.
2. Observe the FM modulator output without any modulator input which is the carrier signal and note down its frequency and amplitude.
3. Connect modulating signal to FM modulator input and observe modulating signal and FM output on two channels of the CRO simultaneously.
4. Adjust the amplitude of the modulating signal until we get less distorted FM output.
5. Apply the FM output to FM demodulator and adjust the potentiometer in demodulation until we get demodulated output.OBSERVATIONS:

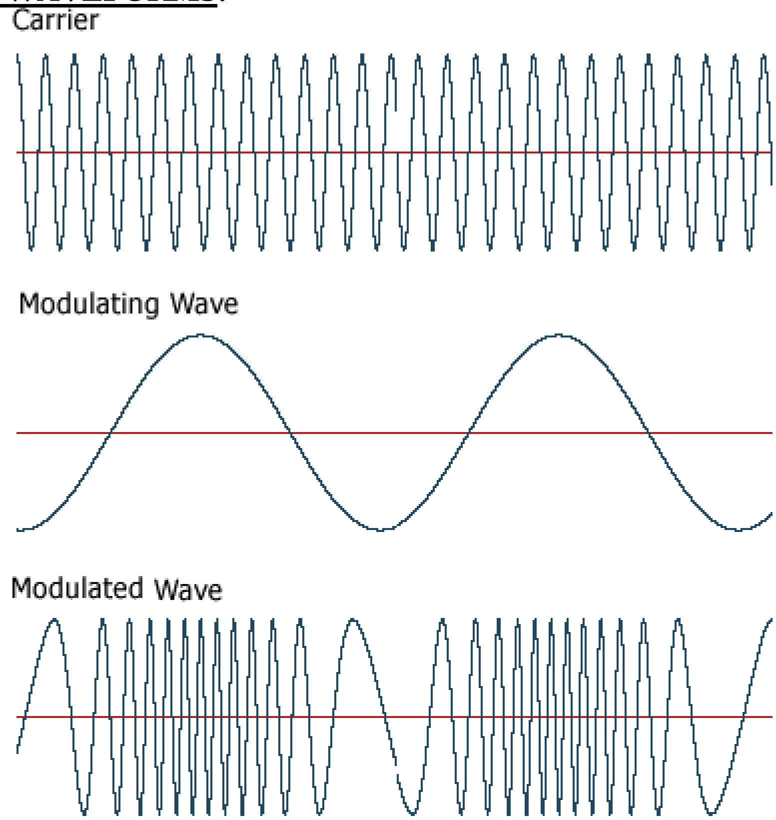
Modulation

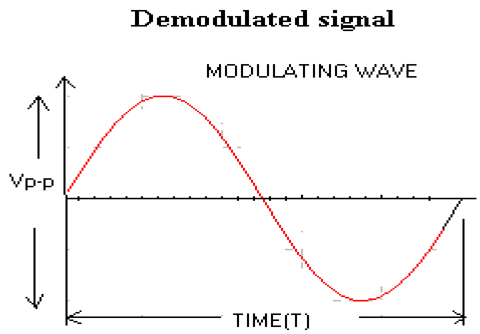
Vm	F1	F2	Frequency deviation Fd (f1-f2)	Modulating index (f1-f2)/Fm	Band width= 2(Fd+Fm)

Demodulation

Modulating signal frequency	Demodulating signal frequency

EXPECTED WAVEFORMS:-





RESULT:

QUESTIONS

1. Define FM & PM.
2. What are the advantages of Angle modulation over amplitude modulation?
3. What is the relationship between PM and FM?
4. With a neat block diagram explain how PM is generated using FM.

EXPERIMENT NO.: 4

PHASE MODULATION AND DEMODULATION

AIM: To study of Phase modulation and demodulation.

APPARATUS :

1. PM modulation and demodulation kit
2. Dual trace CRO.
3. CRO probes
4. Patch cards.

Phase Modulation & Demodulation (PM)

Definition: Phase modulation (PM) is a modulation pattern for conditioning communication signals for transmission. It encodes a message signal as variations in the instantaneous phase of a carrier wave. Phase modulation is one of the two principal forms of angle modulation, together with frequency modulation.

In phase modulation, the instantaneous amplitude of the baseband signal modifies the phase of the carrier signal keeping its amplitude and frequency constant. The phase of a carrier signal is modulated to follow the changing signal level (amplitude) of the message signal. The peak amplitude and the frequency of the carrier signal are maintained constant, but as the amplitude of the message signal changes, the phase of the carrier changes correspondingly.

Message signal:

A message signal contains information or a message. It is the **original signal** that needs to be transmitted from the **transmitter to the receiver**. The transmitter converts the signal into a suitable form and sends it through the communication channel to the receiver. The communication channel is a **medium** for the signal to travel from one end to the other. The receiver perceives the signal, which is converted back to its original form.

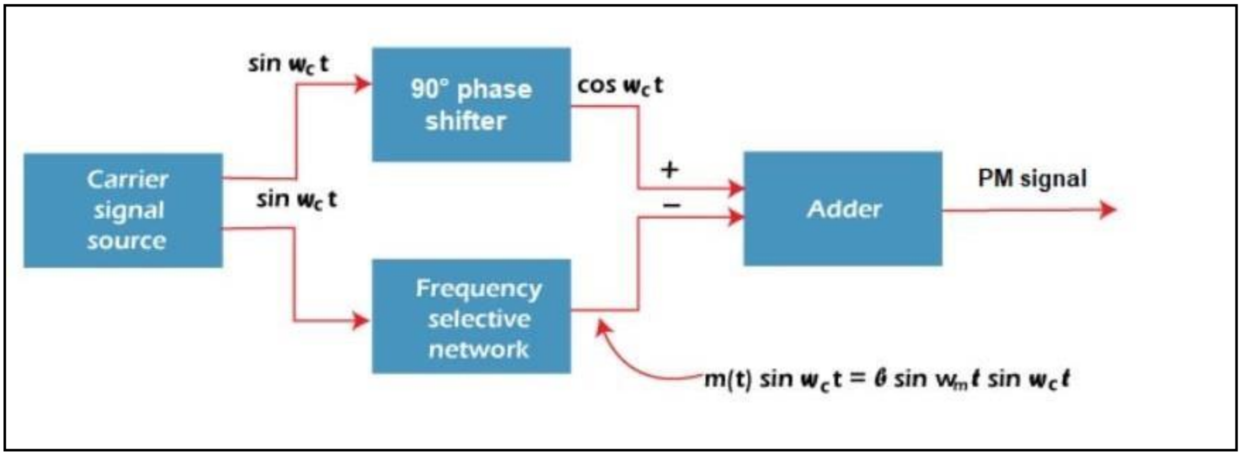
A message signal suffers from attenuation and various noise factors. It is essential to modulate the message signal to remove the noise. It also helps in improving the **efficiency** of the signal. Hence, a message signal is often known as a *modulated signal*. Another name of the message signal is the baseband signal.

Carrier signal:

The carrier signal is the same sinusoidal waveform signal as message signal with greater frequency. It means that the frequency of the carrier signal is higher than the message signal. The Carrier signal is sent with the message signal on the samecommunication channel during the modulation process. When sent with the message signal, the high-frequency carrier signal increases the frequency of the message signal. It is used in applications where the incoming message signal is low frequency, and the required output signal is high frequency.Phase Modulators:

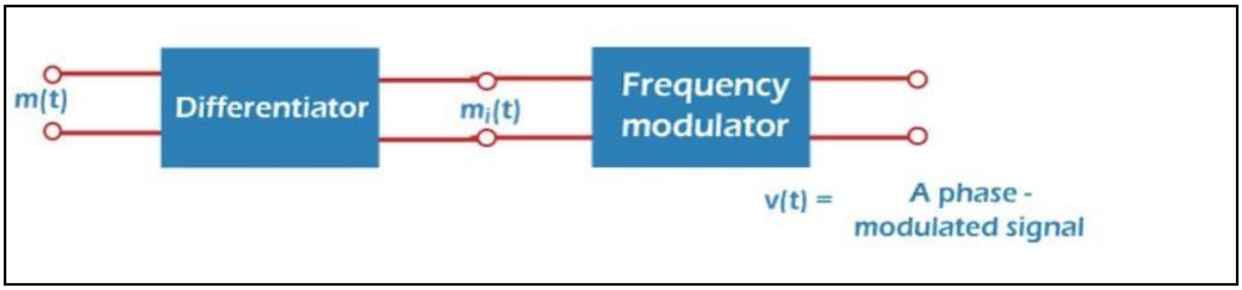
Modulation refers to converting the information signal to a suitable form of transmission. Here, the incoming message signal is converted to radio waves, which is a suitable mode of transmission for the communication system.

The modulation process of PM is similar to the FM modulation process except forthe integrator. FM requires an integrator before the modulated signal is applied to the balanced modulator. The integrator block in FM is present before the balance modulator block. But in PM modulation, no integrator block is required. The block diagram of the PM modulator is shown below:



The circuit consists of a **carrier signal source, balance modulator, adder,** and a **90-degree phase shifter.** The carrier signal source generates a carrier sinωct with the carrier frequency ωc. The 90-degree phase shifter converts the carrier signal sinωct to cosωct, which is the carrier with a phase shift of 90 °. A balance modulator generates a double sideband amplitude modulated signal by superimposing the message and the carrier signal sinωct. The output signal is generally a suppressed carrier signal. The output of the balance modulator and the output of the phase shifter are sent to the adder, which adds these two outputs. The carrier shifted by a phase of 90° when added to the output of the balanced modulator forms a phase-modulated signal.

We can also use a frequency modulator as a phase modulator by passing the FM signal through a differentiator and an FM modulator.



Where, m(t) is the modulated signal

$m_i(t)$ is the instantaneous modulated signal, which is the output of thedifferentiator.

v(t) is the phase modulated signal, output of the frequency modulator.

Graphical Representation of Phase Modulated Wave:

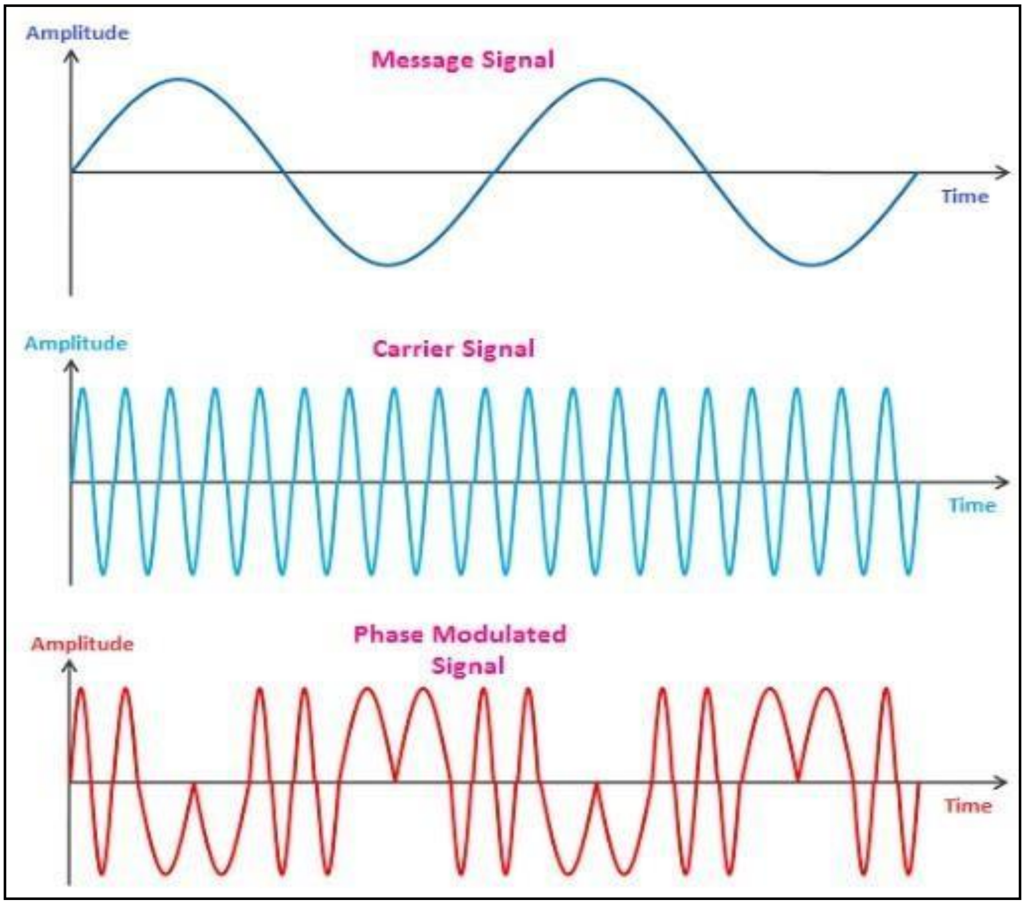


Fig. The output of Phase Modulation.

QUESTIONS

1. Define FM & PM.
2. What are the advantages of Angle modulation over amplitude modulation?
3. What is the relationship between PM and FM?
4. With a neat block diagram explain how PM is generated using FM.

EXPERIMENT No.-5

TITLE: To Study of Sampling Techniques.

AIM OF THE EXPERIMENT:

1. **To obtain the sampled output for given modulating signal input.**
2. Verify the sampling theorem for different modulating frequencies $f_s < 2f_m$, $f_s = 2f_m$ and f_s **$>2f_m$.**
3. Reconstruct the original signal from the sampled signal.

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	Sampling Theorem Trainer Kit		1
2.	Digital storage oscilloscope	100MHz,1GSa/S	1
3.	Power supply		1
4.	Probes		As per req.
5.	Patch cord		As per req.
6.	Connecting wires		As per req.

THEORY:

Sampling is the process of conversion of analog signal to discrete signal. Sampling Theorem shows that acontinuous-time band-limited signal may be represented perfectly by its samples at uniform intervals of T seconds, if T is small enough. In other words, the continuous-time signal may be reconstructed perfectly from its samples; sampling at a high enough rate is information-lossless.

Sampling theorem states that

1. The band limited signal of finite energy, which has no frequency component higher than w hertz, is completely described by specifies the value of signal at instant of time separated by 1/2w second.
2. The band limited signal of finite energy, which has no frequency component higher than w hertz, must be completely recovered from knowledge of its samples taken at rate of 2w per second.

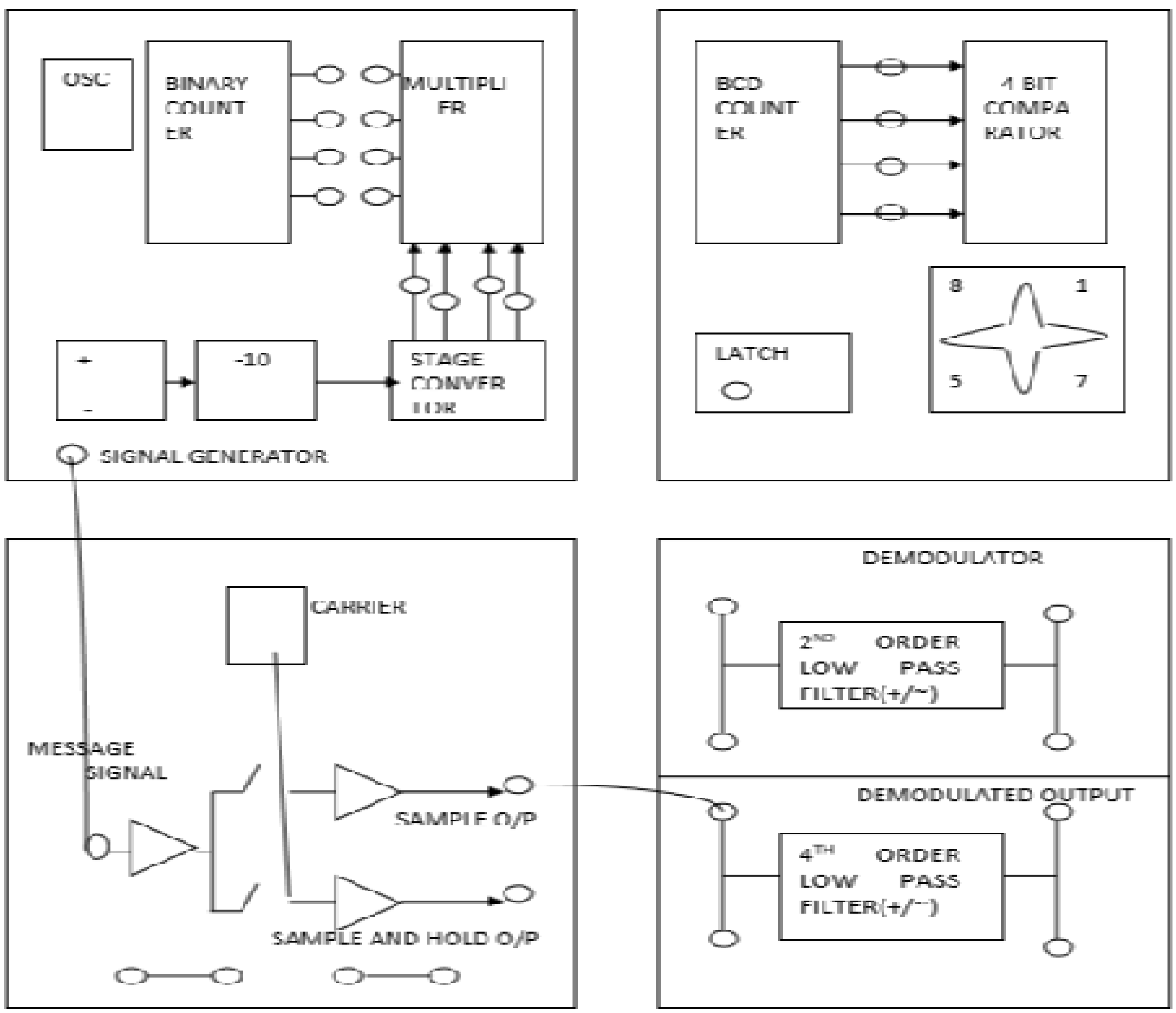
$$F_s >= 2\ f_m$$

If the sampling frequency is less than Nyquist rate, then a distortion is called aliasing.

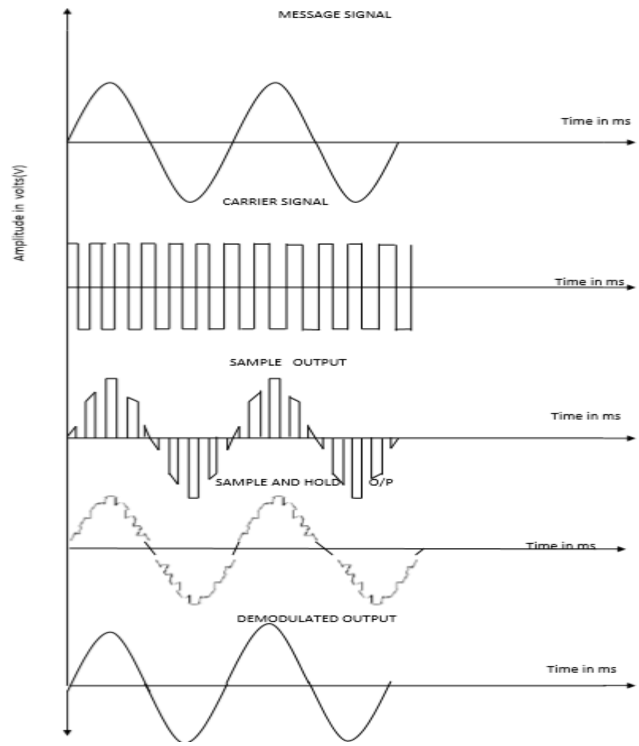
PROCEDURE:

1. Connections are given as per the block diagram.
2. Take the sine wave as input of 1KHZ from signal generator block.
3. Observe the carrier waveform and note down the amplitude and time period of the signal.
4. Observe the sampled signal and note down the amplitude and time period of the signal.
5. Observe the sampled and hold signal and note down the amplitude and time period of the signal.
6. Then the sampled signal is given as an input to low pass filter and then reconstructed waveform isobtained in output of low pass filter.
7. Plot the graph for the Sampled signal and Sample and Hold Signal.

BLOCK DIAGRAM/ CIRCUIT DIAGRAM:



GRAPH:



OBSERVATION:

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

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

RESULTS: The sampling theorem is verified successfully.

CONCLUSION: The modulating signal can be reconstructed from sampled signal successfully whenFs >= 2 fm.

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-6

PULSE AMPLITUDE MODULATION

AIM:-. To Study of Pulse Amplitude Modulation and Time Division Multiplexing
APPARATUS:-

1. Pulse amplitude modulation & demodulation Trainer Kit.
2. Dual trace CRO.
3. Patch chords.
4. PC with windows(95/98/XP/NT/2000)
5. MATLAB Software with communication toolbox

THEORY:-

Pulse modulation is used to transmit analog information. In this system continuous wave forms are sampled at regular intervals. Information regarding the signal is transmitted only at the sampling times together with syncing signals.

At the receiving end, the original waveforms may be reconstituted from the information regarding the samples.

The pulse amplitude modulation is the simplest form of the pulse modulation. PAM is a pulse modulation system is which the signal is sampled at regular intervals, and each sample is made proportional to the amplitude of the signal at the instant of sampling. The pulses are then sent by either wire or cables are used to modulated carrier.

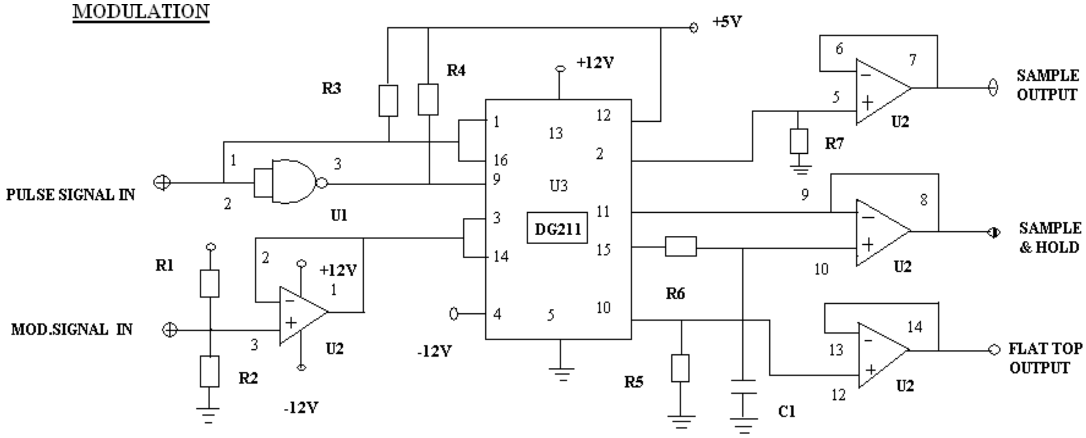
The two types of PAM are i) Double polarity PAM, and ii) the single polarity PAM, in which a fixed dc level is added to the signal to ensure that the pulses are always positive. Instantaneous PAM sampling occurs if the pulses used in the modulator are infinitely short.

Natural PAM sampling occurs when finite-width pulses are used in the modulator, but the tops of the pulses are forced to follow the modulating waveform.

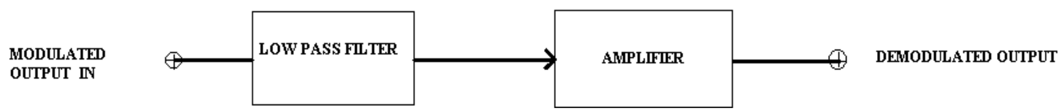
Flat-topped sampling is a system quite often used because of the ease of generating the modulated wave.

PAM signals are very rarely used for transmission purposes directly. The reason for this lies in the fact that the modulating information is contained in the amplitude factor of the pulses, which can be easily distorted during transmission by noise, crosstalk, other forms of distortion. They are used frequently as an intermediate step in other pulse-modulating methods, especially where time-division multiplexing is used.

CIRCUIT DIAGRAM:



DEMODULATION



PROCEDURE:

Double Polarity:-

Modulation:-

1. Connect the circuit as shown in diagram 1.
    a. The output of the modulating signal generator is connected to the modulating signal input TP2 keeping the frequency switch in 1KHz position, and amplitude knob to max position
    b. 16KHz pulse output to pulse input TP1.(Keep the frequency in minimum position in pulse generator block).
2. Switch ON the power supply.
3. Monitor the outputs at TP5, TP6& TP7. And observe the outputs also by varying amplitude pot (Which is in modulation signal generator block).
4. Now vary the frequency selection which position in modulating signal generator block to 2 KHz, amplitude pot to max position.
5. Observe the output at TP5, TP6& TP7 and observe the outputs also by varying amplitude pot (Which is in modulation signal generator block).
6. Repeat all the above steps for the pulse frequency 32KHz (By varying the frequency pot in the pulse generator block).
7. Switch OFF the power supply.

Single Polarity PAM:-

8. Connect the circuit as shown in diagram 2.

a. The output of the modulating signal generator is connected to the modulating signal input TP2 keeping the frequency switch in 1KHz position, and amplitude knob to max position

b. 16KHz pulse output to pulse input TP1 .

9. Switch ON the power supply.

10. Repeat above step 3 to 6 and observe the outputs.

11. Vary DC output pot until you get single polarity PAM at TP5, TP6, TP7.

12. Switch OFF the power supply.

Demodulation:-

1. Connect the circuit as shown in diagram .

    a. The output of the modulating signal generator is connected to the modulating signal input TP2 keeping the frequency switch in 1KHz position, and amplitude knob to max position

    b. 16KHz pulse output to pulse input TP1.

    c. Sample output, sample and hold output and flat top outputs Respectively to the input of low pass filter(TP9) and LPF output (TP10) to AC amplifier input(TP11).

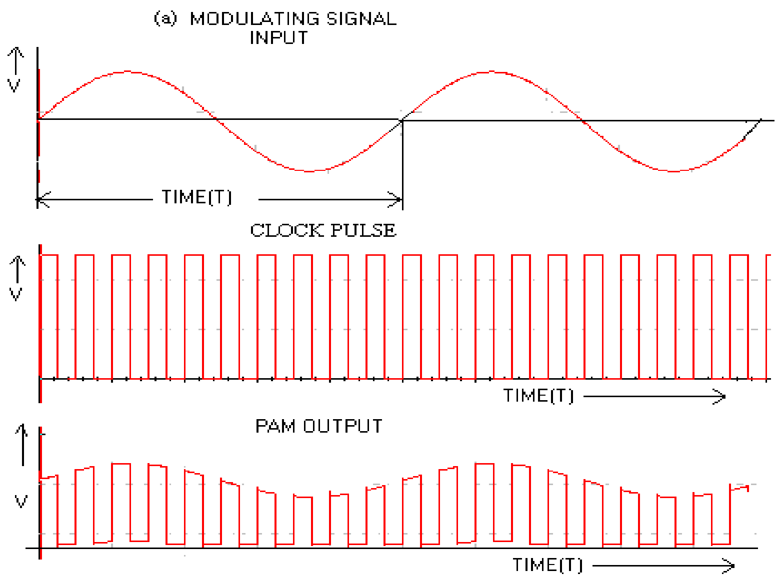
2. Observe the output of LPF and AC amplifier at TP10,TP12 respectively, corresponding to inputs from TP5,TP6 &TP7. The outputs will be the true replica of the input.

3. Now, set the switch position in modulating signal generator to 2KHz and observe the outputs at TP10&TP12 respectively, corresponding to inputs from TP5,TP6& TP7.

4. Vary the frequency of pulse to 32KHz (By varying the frequency pot(Put in max position) in pulse generator block) and repeat the above steps 2&3.

5. Switch OFF the power supply.

EXPECTED WAVEFORMS



RESULT:

QUESTIONS

1. TDM is possible for sampled signals. What kind of multiplexing can be used in continuous modulation systems?
2. What is the minimum rate at which a speech signal can be sampled for the purpose of PAM?
3. What is cross talk in the context of time division multiplexing?
4. Which is better, natural sampling or flat topped sampling and why?
5. Why a dc offset has been added to the modulating signal in this board? Was it essential for the working of the modulator? Explain?
6. If the emitter follower in the modulator section saturates for some level of input signal, then what effect it will have on the output?
7. Derive the mathematical expression for frequency spectrum of PAM signal.
8. Explain the modulation circuit operation?
9. Explain the demodulation circuit operation?
10. Is PAM & Demodulation is sensitive to Noise?

EXPERIMENT NO-7

PULSE WIDTH MODULATION & DEMODULATION

1. To study of Pulse Width Modulation (PWM) and Demodulation Techniques.

AIM: To Study of Pulse Width Modulation & demodulation

APPARATUS:

1. PWM trainer kit
2. C.R.O(30MHz)
3. Patch Chords.
4. PC with windows(95/98/XP/NT/2000)
5. MATLAB Software with communication toolbox

THEORY:-

Pulse modulation is used to transmit analog information. In this system continuous wave forms are sampled at regular intervals. Information regarding the signal is transmitted only at the sampling times together with synchronizing signals.

At the receiving end, the original waveforms may be reconstituted from the information regarding the samples.

The pulse Width Modulation of the PTM is also called as the Pulse Duration Modulation (PDM) & less often Pulse length Modulation (PLM).

In pulse Width Modulation method, we have fixed and starting time of each pulse, but the width of each pulse is made proportional to the amplitude of the signal at that instant.

This method converts amplitude varying message signal into a square wave with constant amplitude and frequency, but which changes duty cycle to correspond to the strength of the message signal.

Pulse-Width modulation has the disadvantage, that its pulses are of varying width and therefore of varying power content. This means that the transmitter must be powerful enough to handle the maximum-width pulses. But PWM still works if synchronization between transmitter and receiver fails, whereas pulse-position modulation does not.

Pulse-Width modulation may be generated by applying trigger pulses to control the starting time of pulses from a mono stable multivibrator, and feeding in the signal to be sampled to control the duration of these pulses.

When the PWM signals arrive at its destination, the recovery circuit used to decode the original signal is a sample integrator (LPF).

CIRCUIT DESCRIPTION:-

Pulse & Modulating Signal Generator:-

A 4.096MHz clock is used to derive the modulating signal, which is generated by an oscillator circuit comprising a 4.096MHz crystal and three 74HC04(U9) inverter gates. This 4.096MHz clock is then divided down in frequency by a factor of 4096, by binary counter 74HC4040(U2), to produce 50% duty cycle, 1KHz square wave on pin no.1 of U4, and 2KHz square wave on pin no.15. the frequency is selectable by means of SW1. This goes to input of fourth order low pass filter U3 is used to produce sine wave from the square wave. The amplitude of this sine wave can be varied.

The square wave which is generated by the oscillator is buffered by inverter 74HC04, to produce 32KHz square wave at pin no.4 of the 74HC4040(U2). This pulse is given to the monostable multi to obtain the 16KHz and 32KHz square wave at the output which are selected by the frequency pot.

Modulation:-

The PWM circuit uses the 555 IC (U1) in monostable mode. The Modulating signal input is applied to pin no.5 of 555IC, and there Pulse input is applied to pin no.2.

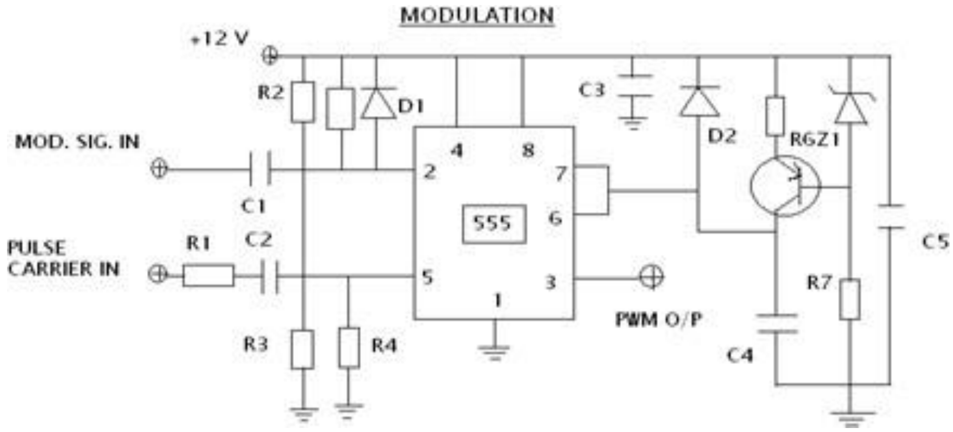
The output of PWM is taken at the pin no.3 of 555IC i.e., TP3.

Demodulation:-

The demodulation section comprises of a fourth order low pass filter and an AC amplifier. The TL074(U5) is used as a low pass filter and an AC amplifier. The output of the modulator is given as the input to the low pass filter.

The low pass filter output is obviously less and it is feed to the AC amplifier which comprises of a single op amp and whose output is amplified.

CIRCUIT DIAGRAM:



PROCEDURE:

Modulation:-

1. Connect the circuit as shown in the diagram 1.
    a. The output of the modulating signal generator is connected to the modulating signal input TP2 keeping the frequency switch in 1KHz position, and amplitude knob to max position
    b. 16KHz pulse output (by varying the frequency pot (put it min position) in pulse generator block) from pulse generator to pulse input(TP1).
2. Switch ON the power supply.
3. Observe the output of pulse width modulation block at TP3.(By varying the amplitude pot).
4. Vary the modulating signal generator frequency by switching the frequency selector switch to 2 KHz.
5. Now, again observe the PWM output at TP3.(By varying the amplitude pot).
6. Repeat the above steps (3 to 5) for the pulse frequency of 32KHz(by varying the frequency pot(put it in max position) in pulse generator block).
7. Switch OFF the power supply.

Demodulation:-

8. Connect the circuit as shown in diagram 2.

a. The output of the modulating signal generator is connected to the modulating signal input TP2 keeping the frequency switch in 1KHz position, and amplitude knob to max position.

b. 16KHz pulse output (put frequency pot minimum) from pulse generator block to pulse input TP1.

c. PWM output to LPF input.

d. LPF output to AC amplifier input.

9. Switch ON the power supply.

10. Observe the output of low pass filter and AC amplifier respectively at TP6 & TP8. The output will be the true replica of the input.

11. Now vary the position of the switch in modulating signal generator to 2 KHz and observe the outputs at TP6 & TP8.

12. Repeat the steps 10& 11 for pulse frequency 32 KHz (By varying the frequency pot (put in max). in pulse generator block). Observe the output waveforms.

13. Switch OFF the power supply.

EXPECTED WAVEFORMS

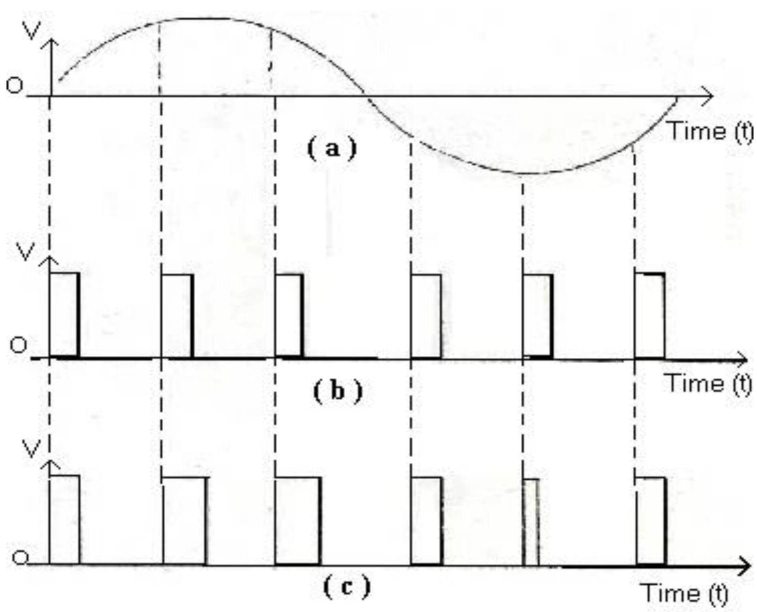


Fig (2) PULSE WIDTH MODULATION
(a) Signal
(b) Unmodulated pulses
(c) PWM

RESULT:

QUESTIONS

1. An audio signal consists of frequencies in the range of 100Hz to 5.5KHz.What is the

minimum frequency at which it should be sampled in order to transmit it through pulse modulation?

2. Draw a TDM signal which is handling three different signals using PWM?

3. What do you infer from the frequency spectrum of a PWM signal?

4. Clock frequency in a PWM system is 2.5 kHz and modulating signal frequency is 500Hzhowmany pulses per cycle of signal occur in PWM output? Draw the PWM signal?

5. Why should the curve for pulse width Vs modulating voltage be linear?

6. What is the other name for PWM?

7. What is the disadvantage of PWM?

8. Will PWM work if the synchronization between Tx and Rx fails?

9. Why integrator is required in demodulation of PWM?

10. What kind of conversion is done in PWM generation?

EXPERIMENT NO-8

PULSE POSITION MODULATION AND DEMODULATION

AIM: To study the generation Pulse Position Modulation (PPM) and Demodulation.

APPARATUS:

1. Pulse Position Modulation (PPM) and demodulation Trainer Kit.
2. C.R.O(30MHz)
3. Patch chords.
4. PC with windows(95/98/XP/NT/2000)
5. MATLAB Software with communication toolbox

THEORY:-

Pulse Modulation is used to transmit analog information in this system continuous wave forms are sampled at regular intervals. Information regarding the signal is transmitted only at the sampling times together with synchronizing signals.

At the receiving end, the original waveforms may be reconstituted from the information regarding the samples. Pulse modulation may be subdivided in to two types analog and digital. In analog the indication of sample amplitude is the nearest variable. In digital the information is a code.

The pulse position modulation is one of the methods of the pulse time modulation.PPM is generated by changing the position of a fixed time slot.

The amplitude& width of the pulses is kept constant, while the position of each pulse, in relation to the position of the recurrent reference pulse is valid by each instances sampled value of the modulating wave. Pulse position modulation into the category of analog communication. Pulse-Position modulation has the advantage of requiring constant transmitter power output, but the disadvantage of depending on transmitter receiver synchronization.

Pulse-position modulation may be obtained very simply from PWM. However, in PWM the locations of the leading edges are fixed, whereas those of the trailing edges are not. Their position depends on pulse width, which is determined by the signal amplitude at that instant. Thus, it may be said that the trailing edges of PWM pulses are, in fact, position-modulated. This has positive-going narrow pulses corresponding to leading edges and negative-going pulses corresponding to trailing edges. If the position corresponding to the trailing edge of an un modulated pulse is counted as zero displacement, then the other trailing edges will arrive earlier or later. They will therefore have a time displacement other than zero; this time displacement is proportional to the instantaneous value of the signal voltage. The differentiated pulses corresponding to the leading edges are removed with a diode clipper or rectifier, and the remaining pulses, is position-modulated.

Circuit Description:-

Modulating Signal Generator:-

A 4.096 MHz clock is used to derive the modulating signal, which is generated by an oscillator circuit comparing a 4.096MHz crystal and three 74HC04(U9) inverter gates. This 4.096 MHz clock is then divided down in frequency by a factor of 4096, by binary counter 74HC4040(U4), to produce 50% duty cycle, 1 KHz square wave on pin no.1 of U4, and 2 KHz square wave on pin no.15. The frequency is selectable by means of SW1. This goes to input of fourth order low pass filter U3 (TL072) is used to produce sine wave from the square wave. The amplitude of this sine wave can be varied.

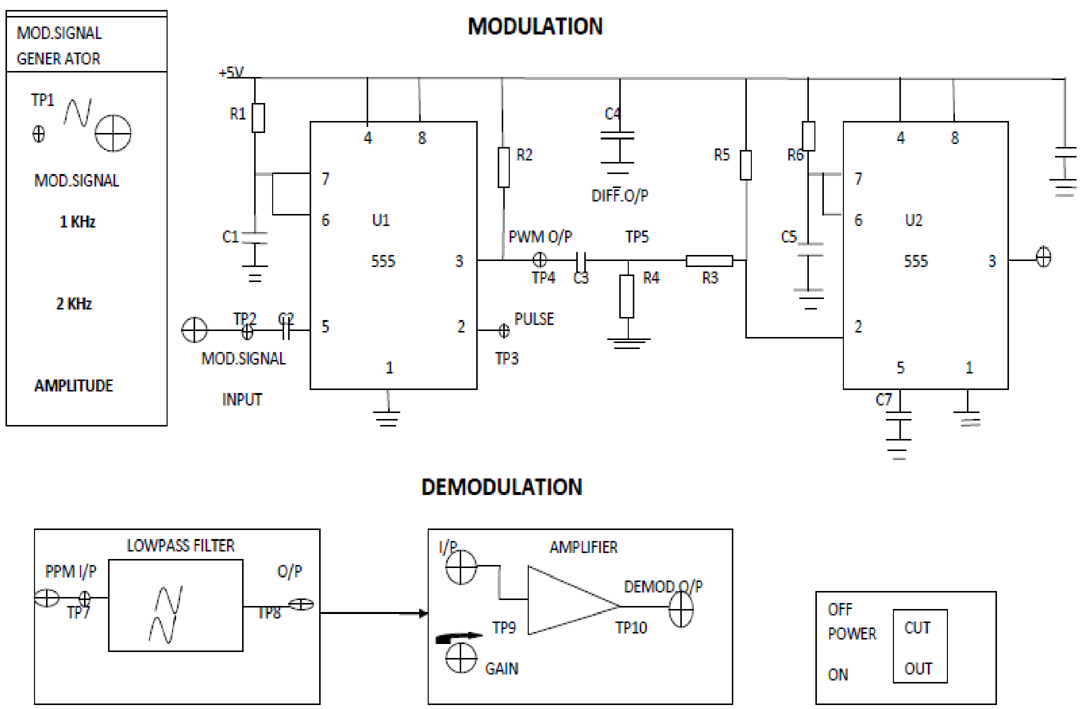
Modulation:-

The circuit uses the IC 555(U1) a Mono stable Multivibrator to perform the pulse position Modulation action.

The Modulating signal is given to Pin No. 5 at Pin No.2 the pulse is 32 KHz which is connected internally.

The PWM is available at TP2; this PWM output is differentiated by using differentiated circuit. This differentiated output is available at TP8. This differentiated output is fed to the 555 IC (U2) (Mono stable Mode) Pin No.2. The PPM output is available at TP3.

CIRCUIT DIAGRAM:



PROCEDURE:

Modulation:

1. Connect the circuit as shown in diagram 1.
   a. Connect the modulating signal generator output to modulating signal input (TP1) in PPM block.
   b. Keep the switch in 1 KHz position and amplitude pot in max position.
2. Switch ON the power supply
3. Observe the PWM output at TP2, and the differentiated output signal at TP8.
4. Now, monitor the PPM output at TP3.
5. Try varying the amplitude and frequency of sine wave by varying amplitude pot.
6. Repeat Step 5 for frequency of 2 KHz and observe the PPM output.
7. Switch OFF the power supply.

Demodulation:-

8. Connect the circuit as shown in diagram2.
   a. Connect the modulating signal generator output to modulating signal input

(TP1) in PPM block.

b. Keep the switch in 1 KHz position and amplitude pot in max position.

c. Connect the PPM output (TP3) to input of LPF(TP4).

9. Switch ON the power supply

10. Observe the demodulated signal at the output of LPF at TP5.

11. Thus the recovered signal is true replica of the input signal

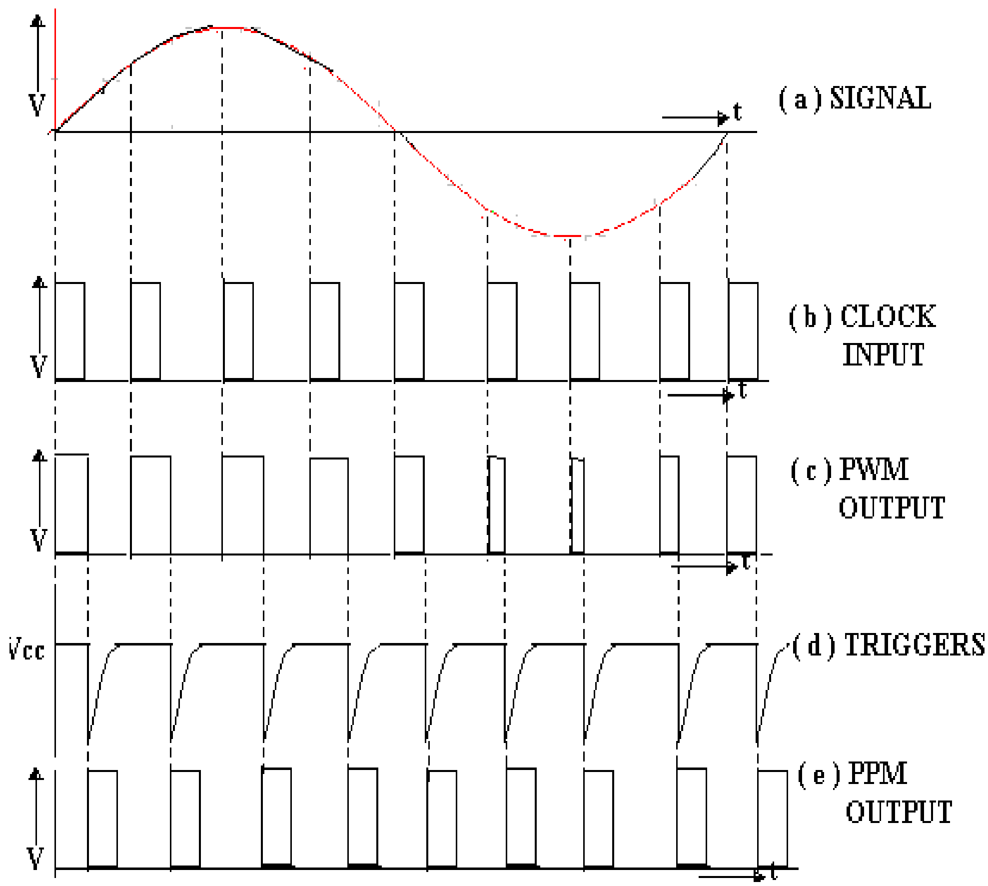
12. a. As the output of LPF has less amplitude, connect the output of LPF to the input of an AC amplifier (TP5 to TP6).

b. Observe the demodulated out put on the oscilloscope at TP7 and also observe the amplitude of demodulated signal by varying gain pot. This is amplitude demodulated output.

13. Repeat the steps (7 to 9) for the modulating signal for frequency 2 KHz.

14. Switch OFF the power supply.

EXPECTED WAVEFORMS:



RESULT:

QUESTIONS:

1. What is the advantage of PPM over PWM?
2. Is the synchronization is must between Tx and Rx
3. Shift in the position of each pulse of PPM depends on what?
4. Can we generate PWM from PPM?
5. Why do we need 555 timers?
6. Does PPM contain derivative of modulating signal compared to PWM?
7. For above scheme, do we have to use LPF and integrator in that order?
8. If we convert PPM to PWM & then detect the message signal, will the o/p has less distortion?
9. Is synchronization critical in PPM?
10. How robust is the PPM to noise?

EXPERIMENT NO-9

PULSE CODE MODULATION & DEMODULATION

Aim: To study of Pulse code Modulation and Demodulation

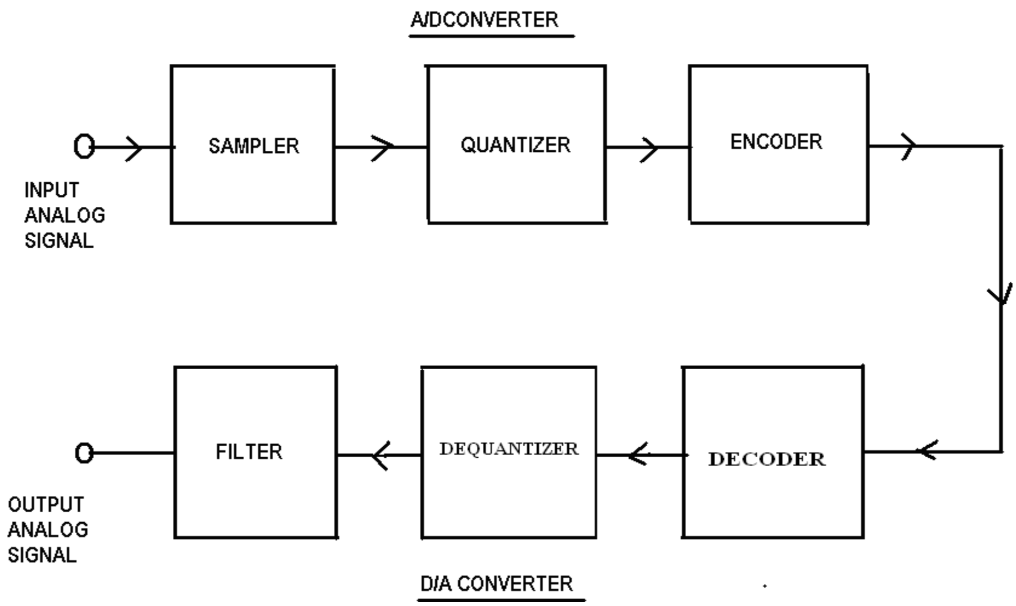
Apparatus:
1. **PCM transmitter trainer.**
2. PCM receiver trainer.
3. CRO and connecting wires.

Theory:

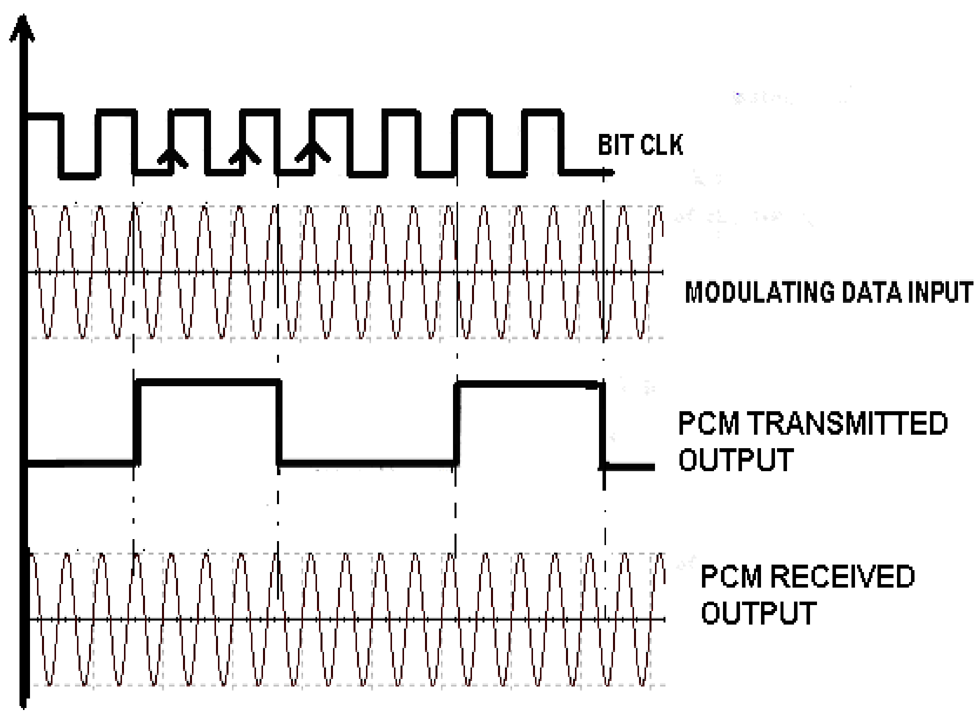
In the PCM communication system, the input analog signal is sampled and these samples are subjected to the operation of quantization. The quantized samples are applied to an encoder. The encoder responds to each such a sample by generation unique and identifiable binary pulse. The combination of quantize and encoder is called analog to digital converter. It accepts analog signal and replaces it with a successive code symbol, each symbol consists of a train of pulses in which the each pulse represents a digit in arithmetic system.

When this digitally encoded signal arrives at the receiver, the first operation to be performed is separation of noise which has been added during transmission along the channel. It is possible because of quantization of the signal for each pulse interval; it has to determine which of many possible values has been receive

Block Diagram:



Output Waveform:



Procedure:

1. The two inputs of function generator are connected to channel -0 and channel-1 simultaneously that is DC1 output to channel -0 and DC2 to channel-1.
2. With the help of oscillator DC1 output is adjusted to 0 volts.
3. Transmitter and receiver are connected by the synchronization of clock pulses and by connecting ground transmitter to ground receiver.
4. The transmitter is connected to the input of receiver to go the original signal at the receiver output.
5. After connection is made the inputs channel 1 and channel 0 are noted. The sampled output of bit channels are taken by connecting DC1 output to channel 0 and DC2 output to channel-1.
6. The phase shift of a channel can be obtained by comparing the input and output of channels at the transmitter block.
7. Thus the output of transmitter can be noted down and input of receiver is similar to that.
8. The receiver output signals are noted down at channel 0 and channel 1 of the receiver block.

Result:

Questions:

1. What is the expression for transmission bandwidth in a PCM system?
2. What is the expression for quantization noise /error in PCM system?
3. What are the applications of PCM?
4. What are the advantages of the PCM?
5. What are the disadvantages of PCM?

EXPERIMENT No.-10

ASK modulation and demodulation

AIM OF THE EXPERIMENT: To study the generation and detection of Amplitude Shift Keying (ASK).

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	ASK modulation and demodulation trainer kit		1
2.	Digital storage oscilloscope	100MHz,1GSa/S	1
3.	Power supply		1
4.	Probes		As per req.
5.	Patch cord		As per req.
6.	Connecting wires		As per req.

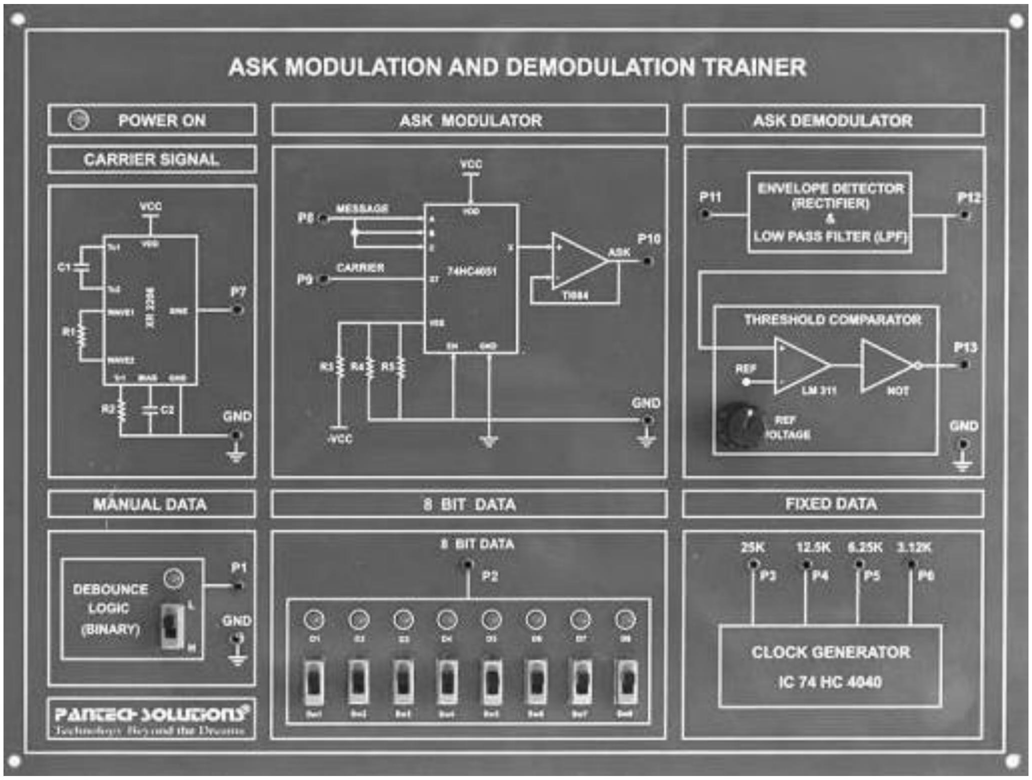
THEORY:

The binary ASK system was one of the earliest form of digital modulation used in wireless telegraphy. In a binary ASK system binary symbol 1 is represented by transmitting a sinusoidal carrier wave of fixed amplitude Ac and fixed frequency fc for the bit duration Tb whereas binary symbol 0 is represented by switching of the carrier for Tb seconds. This signal can be generated simply by turning the carrier of a sinusoidal oscillator ON and OFF for the prescribed periods indicated by the modulating pulse train. For this reason the scheme is also known as on-off shift testing.

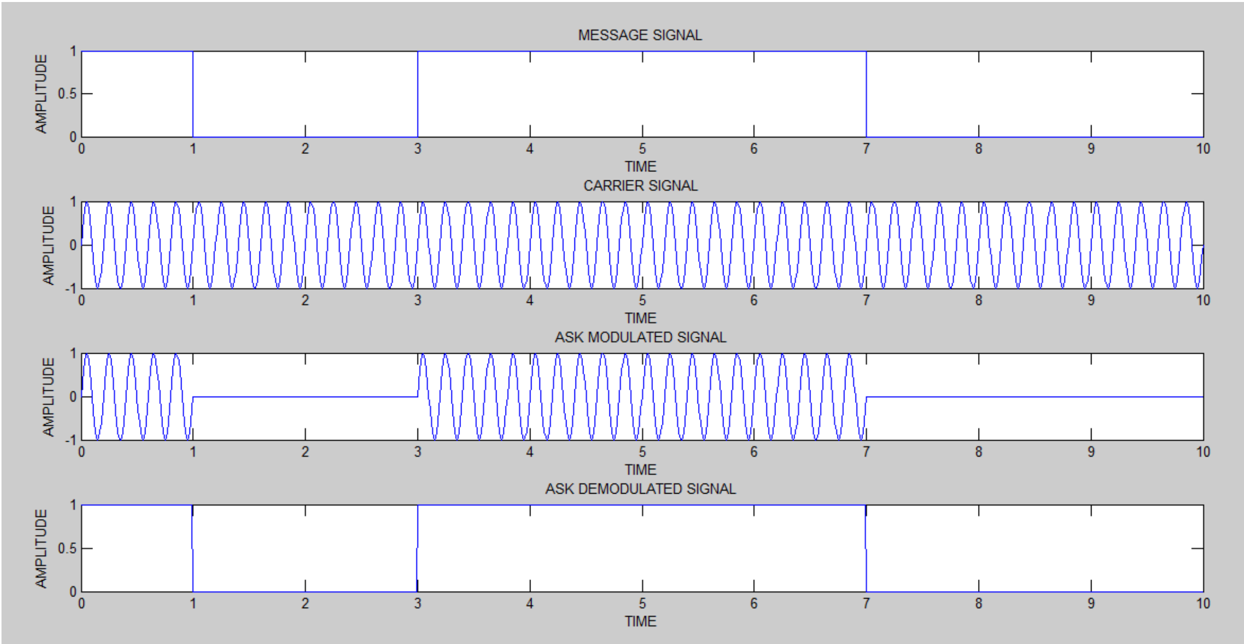
PROCEDURE:

1. The connections are given as per the block diagram.
2. Connect the power supply in proper polarity to the kit and & switch it on.
3. Set the amplitude and frequency of the carrier wave as desired.
4. Set the message data bit.
5. Observe the waveforms at the
    a. Message data
    b. Carrier signal
    c. ASK modulator output
    d. ASK demodulator output
6. Plot it on graph paper.

7. BLOCK DIAGRAM/ CIRCUIT DIAGRAM:



GRAPH:



OBSERVATION:

SIGNAL	AMPLITUDE(v)	TIME PERIOD	FREQUENCY
Message signal			
Carrier Signal			
ASK modulated signal			
Demodulated output			

RESULTS: BASK Modulation and Demodulation are verified in the hardware kit and its waveforms arestudied.

CONCLUSION:

From the above experiment, the amplitude of demodulated signal is obtained as………

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.

Phase Shift Keying (PSK) modulation and demodulation.

AIM OF THE EXPERIMENT: To study the generation and detection of Phase Shift Keying (PSK).

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	PSK modulation and demodulation trainer kit		1
2.	Digital storage oscilloscope	100MHz,1GSa/S	1
3.	Power supply		1
4.	Probes		As per req.
5.	Patch cord		As per req.
6.	Connecting wires		As per req.

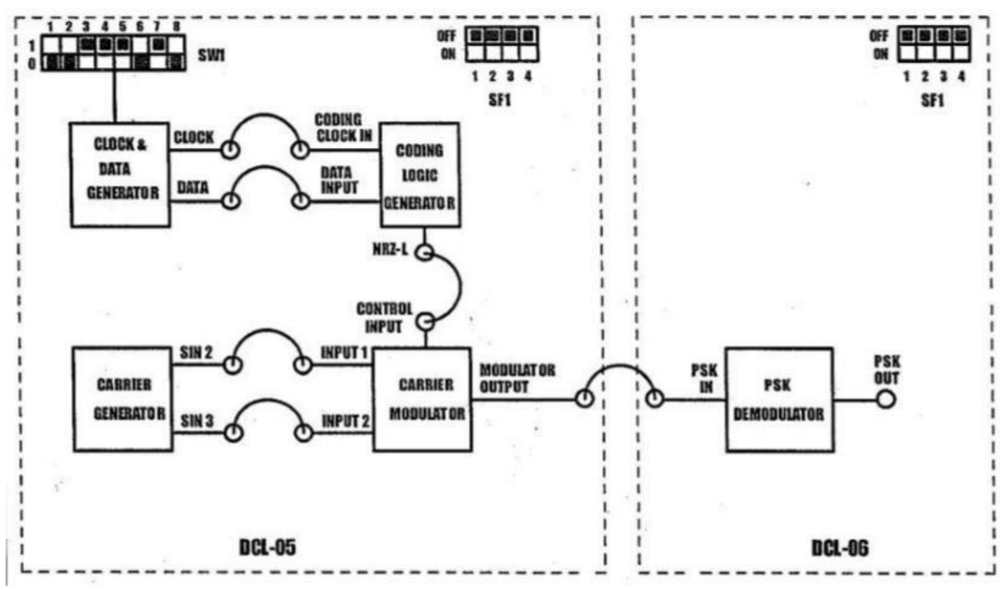
THEORY:

Phase shift keying is a modulation/data transmitting technique in which phase of the carrier signal is shifted between two distinct levels. In a simple PSK (i.e. binary PSK) un-shifted carrier Vcosωt is transmitted to indicate a 1 condition, and the carrier shifted by 180^o i.e. –Vcosωt is transmitted toindicate as 0 condition.

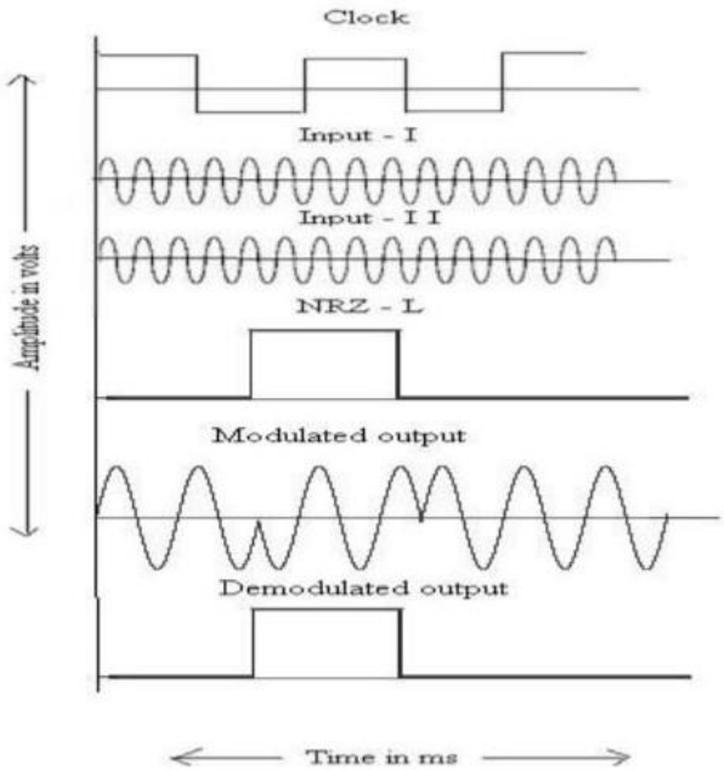
PROCEDURE:

1. The connections are given as per the block diagram.
2. Connect the power supply in proper polarity to the kit and & switch it on.
3. Set the amplitude of the sine wave as desired.
4. Observe the waveforms at the
   a. Clock
   b. SIN 1 & SIN 2
   c. MODULATOR OUTPUT
   d. PSK OUT
5. Plot it on graph paper.

BLOCK DIAGRAM/ CIRCUIT DIAGRAM:



GRAPH:



OBSERVATION:

SIGNAL	AMPLITUDE(v)	TIME PERIOD	FREQUENCY
Clock Signal			
Input1			
Input2			
Modulator Output			
Demodulated output			

RESULTS: BPSK Modulation and Demodulation are verified in the hardware kit and its waveforms arestudied.

CONCLUSION:

From the above experiment, the amplitude of demodulated signal is obtained as………

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.

Frequency Shift Keying (FSK) modulation and demodulation.

AIM OF THE EXPERIMENT: To study the generation and detection of Frequency ShiftKeying (FSK).

EQUIPMENTS/ APPARATUS REQUIRED :

Sl.No.	Name of the Equipment/ Component	Specifications/ Range	Quantity
1.	FSK modulation and demodulation trainer kit		1
2.	Digital storage oscilloscope	100MHz,1GSa/S	1
3.	Power supply		1
4.	Probes		As per req.
5.	Patch cord		As per req.
6.	Connecting wires		As per req.

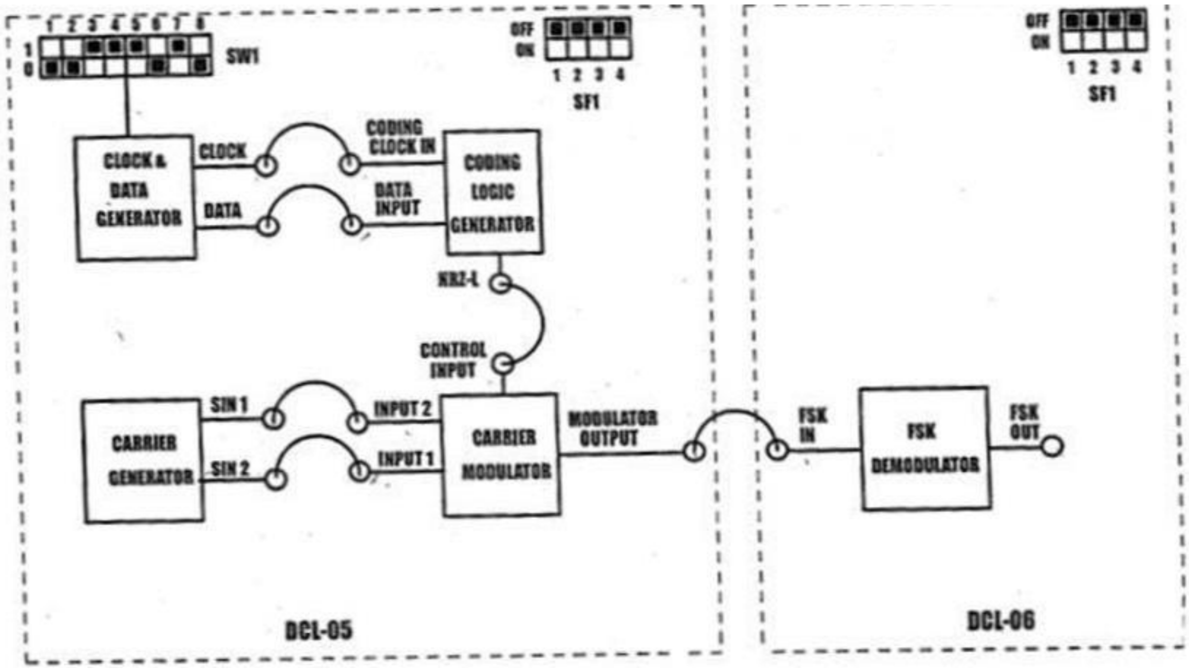
THEORY:

FSK signaling schemes find a wide range of applications in low-speed digital data transmission system. FSK schemes are not as efficient as PSK in terms of power and bandwidth utilization. In binary FSK signaling the waveforms are used to convey binary digits 0 and 1 respectively. The binary FSK waveform is a continuous, phase constant envelope FM waveform. The FSK signal bandwidth in this case is of orderof 2MHz, which is same as the order of the bandwidth of PSK signal.

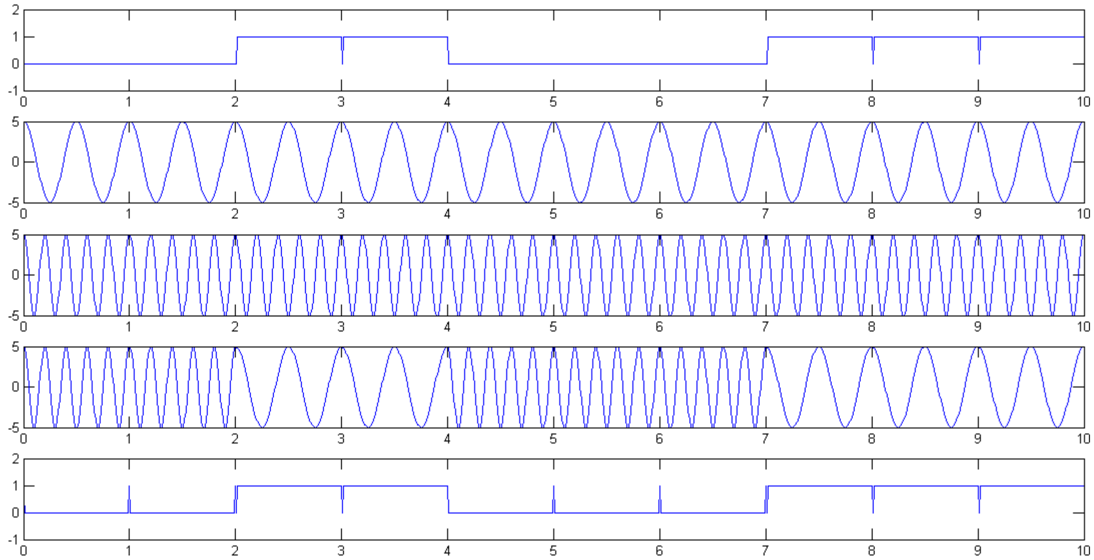
PROCEDURE:

1. The connections are given as per the block diagram.
2. Connect the power supply in proper polarity to the kit and & switch it on.
3. Set the amplitude of the sine wave as desired.
4. Observe the waveforms at the
   i. Clock
   j. SIN 1 & SIN 2
   k. MODULATOR OUTPUT
   l. PSK OUT
5. Plot it on graph paper

BLOCK DIAGRAM/ CIRCUIT DIAGRAM:



GRAPH:



OBSERVATION:

SIGNAL	AMPLITUDE(v)	TIME PERIOD	FREQUENCY
Clock Signal			
Input1			
Input2			
Modulator Output			
Demodulated output			

RESULTS: BFSK Modulation and Demodulation are verified in the hardware kit and its waveforms are studied.

CONCLUSION:

From the above experiment, the amplitude of demodulated signal is obtained as………

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.