JEPPIAAR
ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

EC3461 -COMMUNICATION SYSTEMS LABORATORY

(R-2021)

II year -IV SEM– ECE

RECORD NOTE-BOOK

ACADEMIC YEAR: 2024-2025

NAME : ______________________________

ROLL NO. : ______________________________

REG NO. : ______________________________

YEAR : ______________________________

SECTION : ______________________________

BATCH: ______________________________

JEPPIAAR ENGINEERING COLLEGE

Vision of the Institute	To build Jeppiaar Engineering College as an institution of academic excellence in technological and management education to become a world class University	
Mission of the Institute	**M1**	To excel in teaching and learning, research and innovation by promoting the principles of scientific analysis and creative thinking
	M2	To participate in the production, development and dissemination of knowledge and interact with national and international communities.
	M3	To equip students with values, ethics and life skills needed to enrich their lives and enable them to meaningfully contribute to the progress of society
	M4	To prepare students for higher studies and lifelong learning, enrich them with the practical and entrepreneurial skills necessary to excel as future professionals and contribute to Nation's economy

DEPARTMENT: ELECTRONICS AND COMMUNICATION ENGINEERING

sion of the Department	To become a centre of excellence to provide quality education and produce creative engineers in the field of Electronics and Communication Engineering to excel at international level.	
Mission of the Department	**M1**	Inculcate creative thinking and zeal for research to excel in teaching-learning process
	M2	Create and disseminate technical knowledge in collaboration with industries
	M3	Provide ethical and value based education by promoting activities for the betterment of the society
	M4	Encourage higher studies, employability skills, entrepreneurship and research to produce efficient professionals thereby adding value to the nation's economy

PROGRAM OUTCOMES (PO)	**PO 1**	**Engineering knowledge**: **Apply** the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
	PO 2	**Problem analysis**: **Identify, formulate, review** research literature, and **analyze** complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
	PO 3	**Design/development of solutions**: **Design solutions** for complex engineering problems and **design** system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
	PO 4	**Conduct investigations of complex problems**: **Use** research-based knowledge and research methods including **design** of experiments, **analysis** and **interpretation** of data, and **synthesis** of the information to provide valid conclusions.
	PO 5	**Modern tool usage**: **Create**, **select**, and **apply** appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
	PO 6	**The engineer and society**: **Apply** reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
	PO 7	**Environment and sustainability**: **Understand** the impact of the professional engineering solutions in societal and environmental contexts, and **demonstrate** the knowledge of, and need for sustainable development.
	PO 8	**Ethics**: **Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
	PO 9	**Individual and team work**: **Function effectively** as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
	PO 10	**Communication**: **Communicate effectively** on complex engineering activities with the engineering community and with society at large, such as, being able **to comprehend** and **write** effective reports and **design** documentation, **make** effective presentations, and **give** and **receive** clear instructions.
	PO 11	**Project management and finance**: **Demonstrate** knowledge and understanding of the engineering and management principles and **apply** these to one's own work, as a member and leader in a team, to **manage** projects and in multidisciplinary environments.
	PO 12	**Life-long learning**: **Recognize** the need for, and have the preparation and ability to **engage** in independent and life-long learning in the broadest context of technological change.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)	**PEO I**	Produce technically competent graduates with a solid foundation in the field of Electronics and Communication Engineering with the ability to analyze, design, develop, and implement electronic systems.
	PEO II	Motivate the students for choosing the successful career choices in both public and private sectors by imparting professional development activities.
	PEO III	Inculcate the ethical values, effective communication skills and develop the ability to integrate engineering skills to broader social needs to the students.
	PEO IV	Impart professional competence, desire for lifelong learning and leadership skills in the field of Electronics and Communication Engineering.
PROGRAM SPECIFIC OUTCOMES (PSOs)	**PSO 1**	Design, develop and analyze electronic systems through application of relevant electronics, mathematics and engineering principles.
	PSO 2	Design, develop and analyze communication systems through application of fundamentals from communication principles, signal processing, and RF System Design & Electromagnetics.
	PSO 3	Adapt to emerging electronics and communication technologies and develop innovative solutions for existing and newer problems.

COURSE OBJECTIVES :

- To study the AM & FM Modulation and Demodulation.
- To learn and realize the effects of sampling and TDM.
- To understand the PCM & Digital Modulation.
- To Simulate Digital Modulation Schemes.
- To Implement Equalization Algorithms and Error Control Coding Schemes.

COURSE OUTCOMES:

At the end of the laboratory course, the student will be able to understand the:

CO1: Design AM, FM & Digital Modulators for specific applications.
CO2: Compute the sampling frequency for digital modulation**.**
CO3: Simulate & validate the various functional modules of Communication system.
CO4: Demonstrate their knowledge in base band signaling schemes through implementation of digital
modulation schemes.
CO5: Apply various channel coding schemes & demonstrate their capabilities towards the
improvement of the noise performance of Communication system.

CO's-PO's & PSO's MAPPING

CO	**POs**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
1	3	3	3	3	3	3	-	-	-	1	1	1
2	3	3	3	3	3	2	-	-	-	1	1	1
3	3	3	3	3	3	2	-	-	-	1	1	1
4	3	3	3	3	3	3	-	-	-	1	1	1
5	3	3	3	3	3	2	-	-	-	1	1	1
Avg	3	3	3	3	3	2.5	-	-	-	1	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

JEPPIAAR ENGINEERING COLLEGE

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Register Number…………………………….. Submitted for the Anna University practical Examination held on …………………… in ………………………………………………………..Laboratory During the year ………. to …………

Signature of the Lab-in-charge

Signature of Head of the Department

EXAMINERS:

Date………………..

Internal………………………

External………………………

INDEX

S.NO	Date	LIST OF EXPERIMENTS	Date of Submission	Marks	Sign
1.		AM- Modulator and Demodulator			
2.		FM - Modulator and Demodulator			
3.		Pre-Emphasis and De-Emphasis			
4.		Signal sampling			
5.		TDM			
6.		Pulse Code Modulation and Demodulation			
7.		Pulse Amplitude Modulation and Demodulation.			
8.		Pulse Position Modulation and Demodulation			
9.		Pulse Width Modulation and Demodulation			
10.		Digital Modulation – ASK, FSK			
11.		Digital Modulation –PSK			
12.		Delta Modulation and Demodulation			
13.		Simulation of ASK, FSK, and BPSK Generation and Detection Schemes			
14.		Simulation of DPSK, QPSK and QAM Generation and Detection Schemes			
15.		Simulation of Linear Block and Cyclic Error Control coding Schemes			

EXP. NO:1	AM - MODULATOR AND DEMODULATOR
DATE:	

AIM:

To construct amplitude modulator and demodulator circuit and plot the waveforms

Apparatus Required:

S.No.	Name of the Equipment /Component	Range	Quantity
1.	Diode	OA79	2
2.	Capacitor	0.1µF,0.01µF	2,1
3.	Resistors	1kΩ,100kΩ	2 ,1 each
4.	Decade Inductance Box	10 mH	1
5.	Function Generators	1 MHz	2
6.	CRO	20MHz	1
7.	Bread board		1
8.	Regulated power supply	0-30 V	1

Theory:

Modulation is the process of changing the amplitude of a relatively high frequency carrier signal in proportion with the instantaneous value of the modulating signal. The output waveform contains all the frequencies that make up the AM signal and is used to transport the information through the system. Therefore the shape of the modulated wave is called the AM envelope. With no modulating signal the output waveform is simply the carrier signal.

Modulation Index:

The ratio of maximum of modulating signal to maximum amplitude of carrier signal is called modulation index . M=Em/Ec .If modulation index expressed in percentage it is also called as percentage modulation. Coefficient of modulation is a term used to describe the amount of amplitude change present in an AM waveform. There are three degrees of modulation available based on value of modulation index.

1) Under modulation : m< 1=Em < Ec
2) Critical modulation: m=1, Em = Ec
3) Over modulation: m>1, Em > Ec

Need for modulation is as follows:

- Avoid mixing of signals
- Reduction in antenna height
- long distance communication
- Multiplexing
- Improve the quality of reception
- Ease of radiation

Advantage

Modulator operates at low voltage level

Power efficiency is practically higher than 80%

All the preceding linear amplifier operates at low power level.

Disadvantages

Requires high amplitude of modulating signal

Small operating range

Application

1) Commercial broadcasting of both audio and video signals

2) Two way mobile radio communication such as citizen band (CB) radio

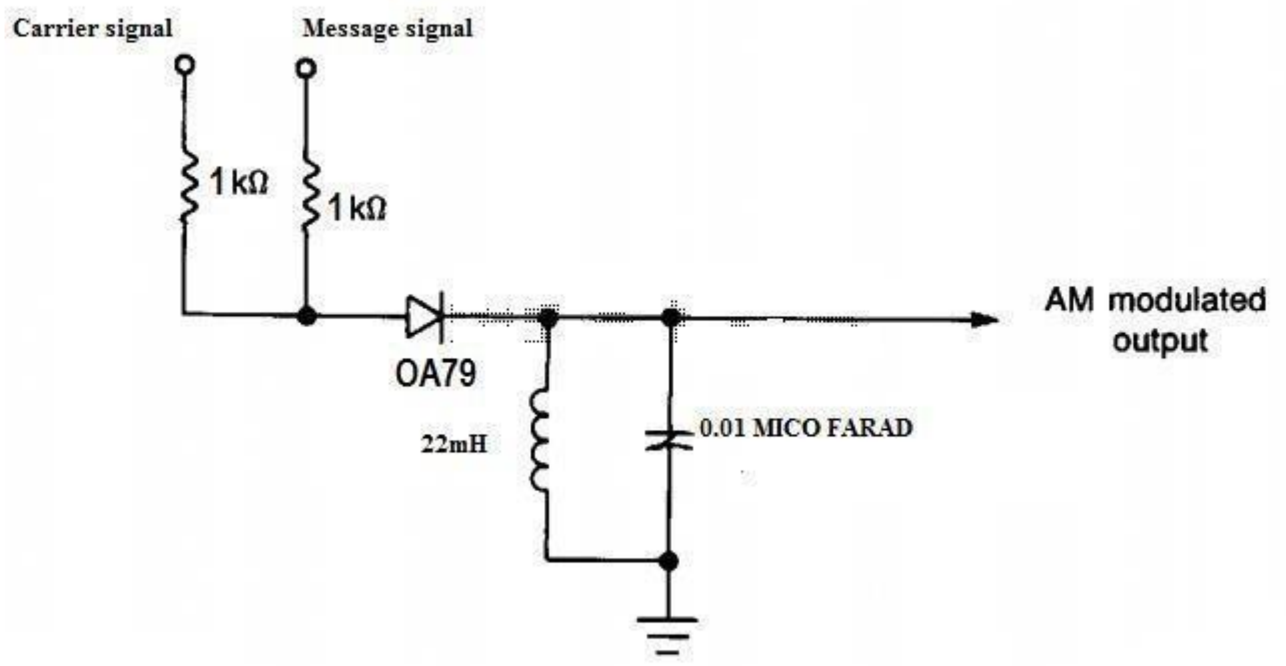
DEMODULATION

It is the process of separating message signal from the modulated wave carrier signal. The most commonly used AM detector is simple diode detector .the AM signal at fixed if is applied to the transformer primary. The signal at secondary is half wave rectified by diode .so that only it is called detector negative peak clipping is done using the detector circuit. This is the distortion occurs in the output of diode detector because of unequal ac and dc load impedences of the diode .

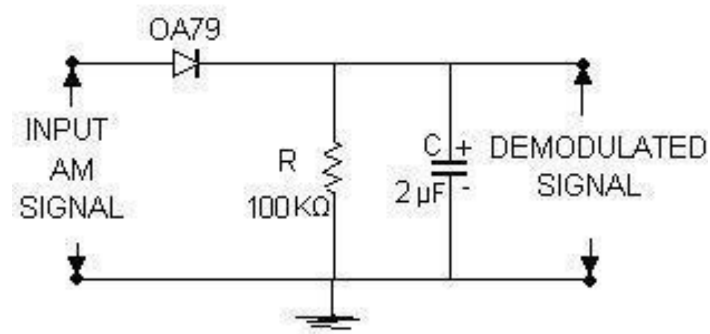
PROCEDURE

1. Rig up the circuit as per the circuit diagram.
2. Modulating frequency is kept at 1 KHZ.
3. Carrier frequency is kept at 10KHZ
4. The output waveform is observed in CRO and measure Vmax&Vmin are calculated, modulation index calculated.
5. Output and input characteristics are plotted in graph.
6. Apply the AM signal to the detector circuit.
7. Observe the amplitude demodulated output on the CRO.
8. Compare the demodulated signal with the original modulating signal (Both must be same in all parameters). Plot the observed waveforms.

CIRCUIT DIAGRAM



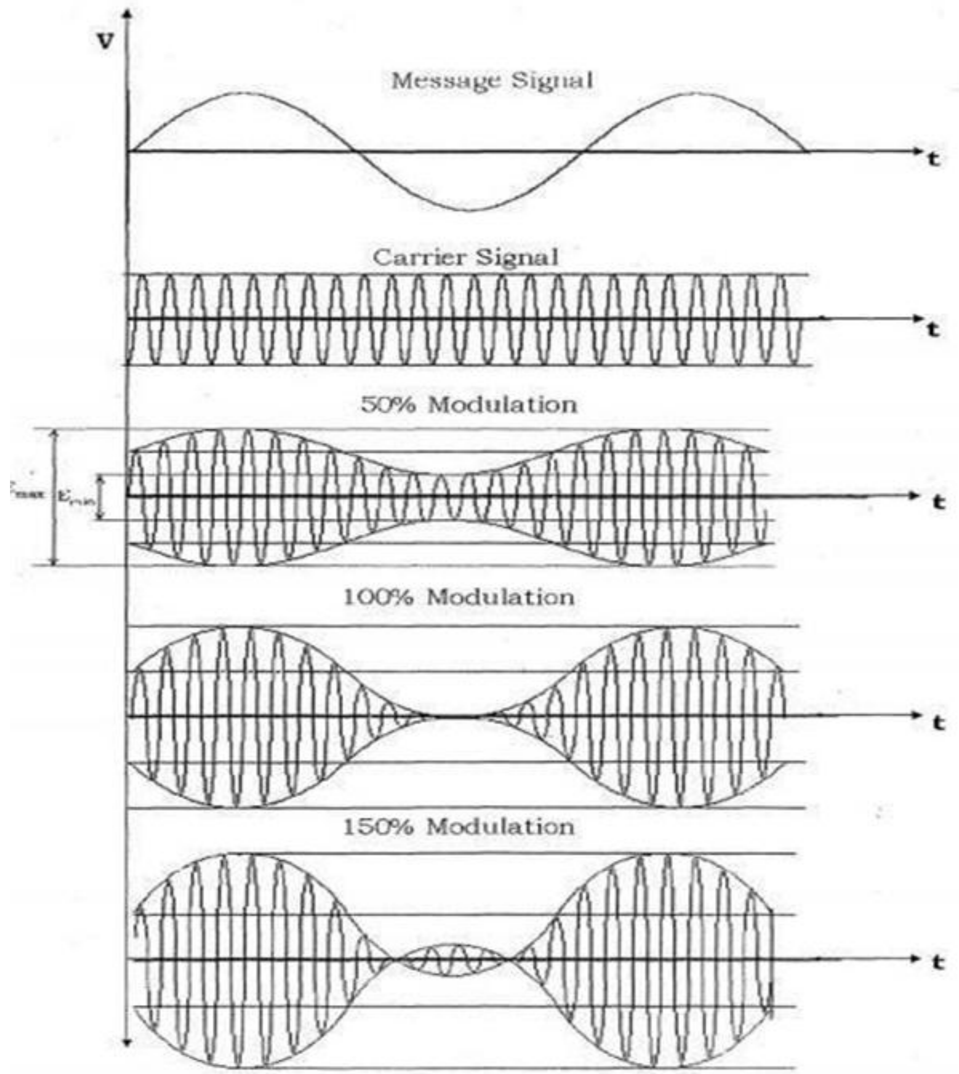
DEMODULATION:



Tabulation:

SIGNAL	AMPLITUDE(V)	TIME PERIOD(ms)	FREQUENCY(HZ)
Input signal			
Carrier signal			
Am signal	V max= V min=		
Demodulated signal			

MODEL GRAPH:



RESULT:

The amplitude modulation & demodulation circuit has been constructed and its characteristics are obtained.

EXP. NO:2	FM - MODULATOR AND DEMODULATOR
DATE:	

Aim:

To construct an Frequency modulation& demodulation circuit and to calculate modulation index of FM.

Apparatus Required:

s.no	components	Range	Qty
1	IC	XR 2206	
2	Resistor		
3	Capacitor		
4	Connecting wires		
5	Function generator	0-100 k HZ	
6	C.R.O	0-60 MHZ	
7	Regulated power supply	0-30 V	

Theory:

When frequency of the carrier varies as per amplitude variations of modulating signal then it is called frequency modulation .Amplitude of the modulated carrier remains constant the frequency modulated wave is given by $u(t) = A_c \cos(2\pi f_c t + \beta \sin(2\pi f_m t))$

FREQUENCY DEVIATION (Δf) and MODULATION INDEX (β): The frequency deviation Δf represents the maximum shift between the modulated signal frequency, over and under the frequency of the carrier.

$$\Delta f = \frac{f_{max} - f_{min}}{2}$$

We define modulation index m f the ratio between Δf and the modulating frequency f.

$$m_f = \frac{\Delta f}{f}$$

DIRECT METHOD:

An oscilloscope is used in which the reactance of one of the elements of the resonant circuit depends on the modulating voltage. The most common device with variable reactance is the Varactor or Varicap, which is a particular diode which capacity varies as function of the reverse bias voltage. The frequency of the carrier is established with AFC circuits (Automated frequency control) or PLL (Phase locked loop).

INDIRECT METHOD:

The FM is obtained in this case by a phase modulation, after the modulating signal has been integrated. In this phase modulator the carrier can be generated by a quartz oscillator, and so its frequency stabilization is easier. In the circuit used for the exercise, the frequency modulation is generated by a Hartley oscillator, which frequency is determined by a fixed inductance and by capacity (variable) supplied by varicap diodes.

ADVANTAGES:
1. Noise reduction
2. Improved system fidelity
3. Efficient use of power

DISADVANTAGE:
1. Requires a wider bandwidth
2. Utilizing more complex circuit in both transmitters and receivers.

APPLICATION:
1. Television sound transmission
2. Two way mobile radio
3. Cellular Radio
4. Microwave
5. Satellite Communication System

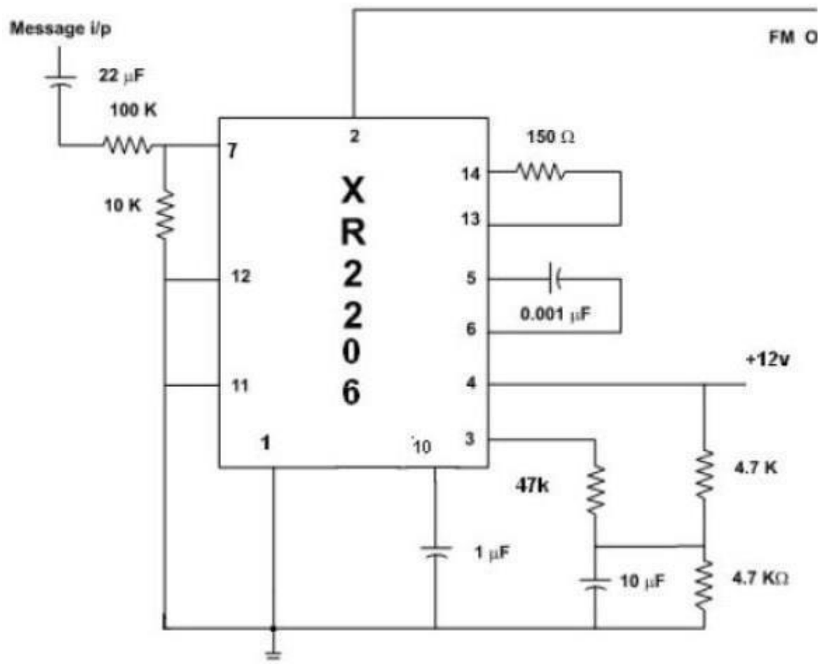
PROCEDURE

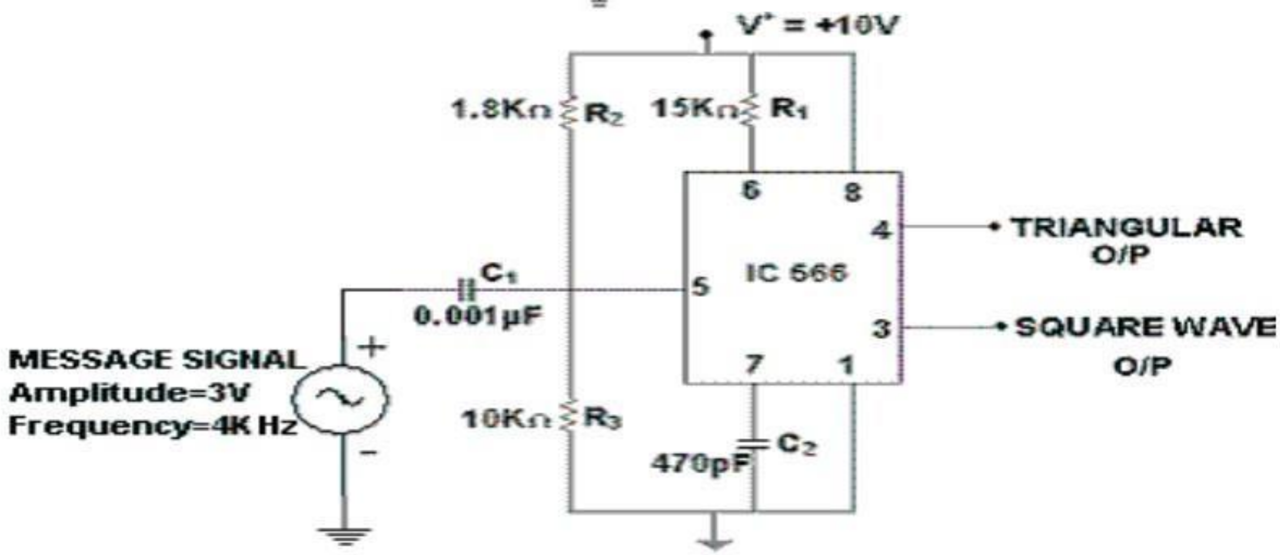
- Connection are given as per circuit diagram For FM carrier is generated without giving input with RT & CT
- Note amplitude and frequency of carrier wave
- By giving input through function generator set a particular frequency
- The output modulated wave is traced and its amplitude and frequency are computed

The demodulation is done by given modulated output wave as input toi demodulator o/p is obtained.

DIAGRAM:

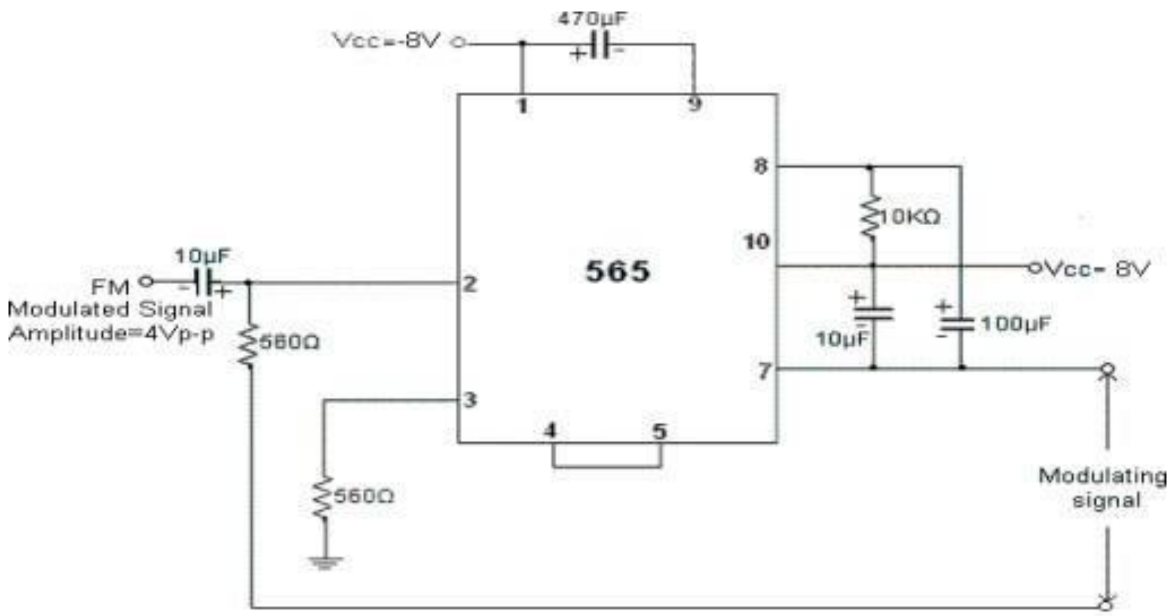
FM Modulator Using IC XR2206





FM Modulator Using IC 566

DEMODULATOR

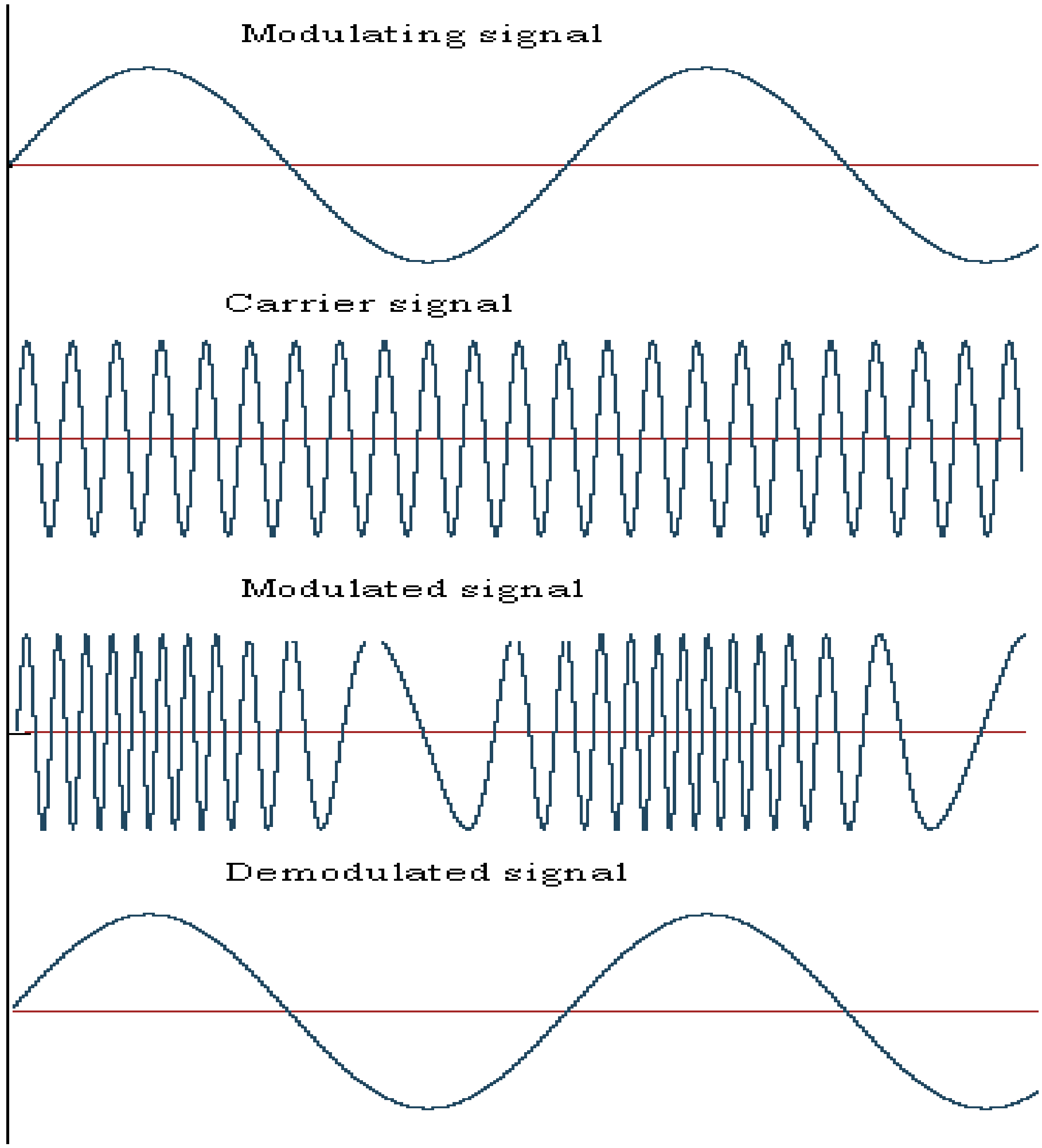


FM Demodulator Circuit

TABULATION

Signal	Amplitude (V)	Time Period (s)	Frequency (Hz)
Message			
Carrier			
Modulated			
Demodulated			

MODEL GRAPH:



RESULT:

The frequency modulation & demodulation circuit has been constructed and its characteristics are obtained.

EXP. NO:3	PRE EMPHASIS - DE EMPHASIS
DATE:	

Aim:

i) To observe the effects of Pre-emphasis on given input signal.

ii) ii) To observe the effects of De-emphasis on given input signal.

Apparatus Required:

Name of the Component/Equipment	Specifications/Range	Quantity
Transistor (BC 107)	f_T = 300 MHz P_d = 1W I_c(max) = 100 mA	1
Resistors	10 KΩ, 7.5 KΩ, 6.8 KΩ	1 each
Capacitors	10 nF 0.1 µF	1 2
CRO	20MHZ	1
Function Generator	1MHZ	1
Regulated Power Supply	0-30V, 1A	1

Theory:

The noise has a effect on the higher modulating frequencies than on the lower ones. Thus, if the higher frequencies were artificially boosted at the transmitter and correspondingly cut at the receiver, an improvement in noise immunity could be expected, thereby increasing the SNR ratio. This boosting of the higher modulating frequencies at the transmitter is known as pre-emphasis and the compensation at the receiver is called de-emphasis

Circuit Diagrams:

For Pre-emphasis:

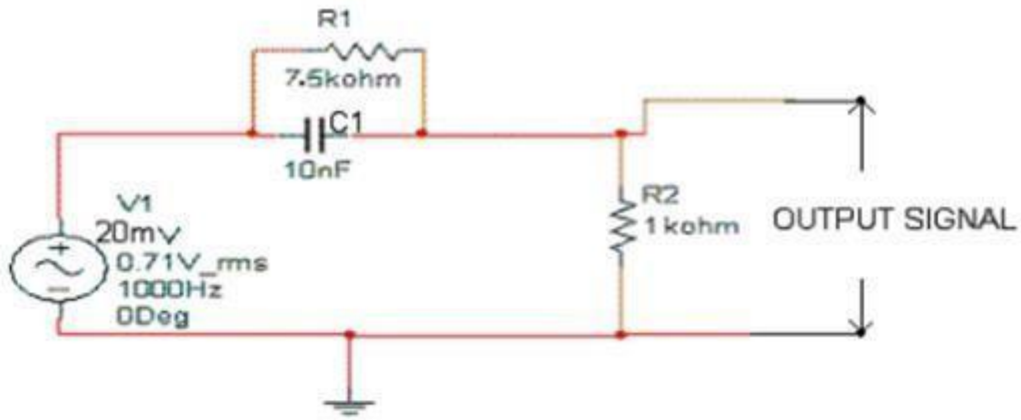


Fig. 1. Pre-emphasis circuit

For De-emphasis:

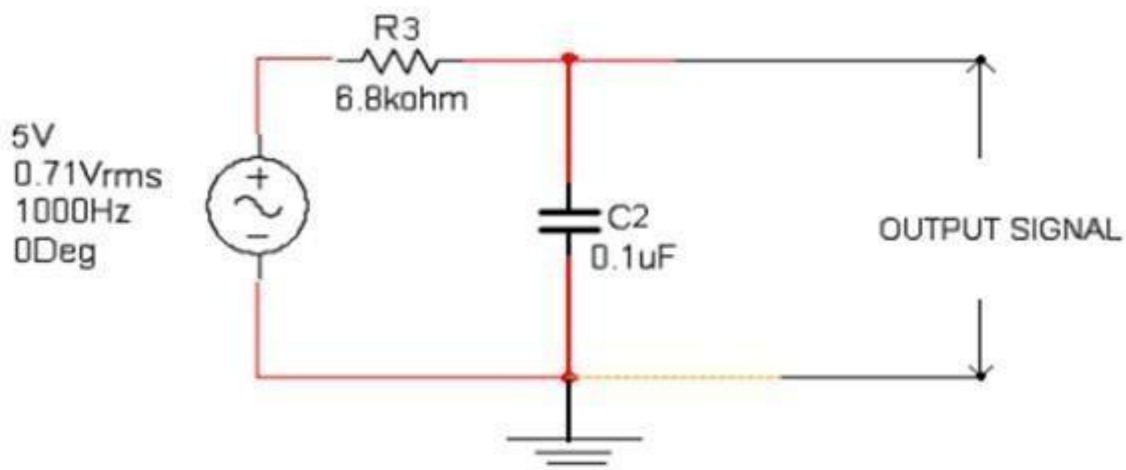


Fig .2. De-emphasis circuit

Procedure:

1. Connect the circuit as per circuit diagram as shown in Fig.1.
2. Apply the sinusoidal signal of amplitude 20mV as input signal to pre emphasis circuit.
3. Then by increasing the input signal frequency from 500Hz to 20 KHz, observe the output voltage (vo) and calculate gain (20 log (vo/vi).
4. Plot the graph between gain Vs frequency. 5. Repeat above steps 2 to 4 for de-emphasis circuit (shown in Fig.2). by applying the sinusoidal signal of 5V as input signal.

Sample readings:

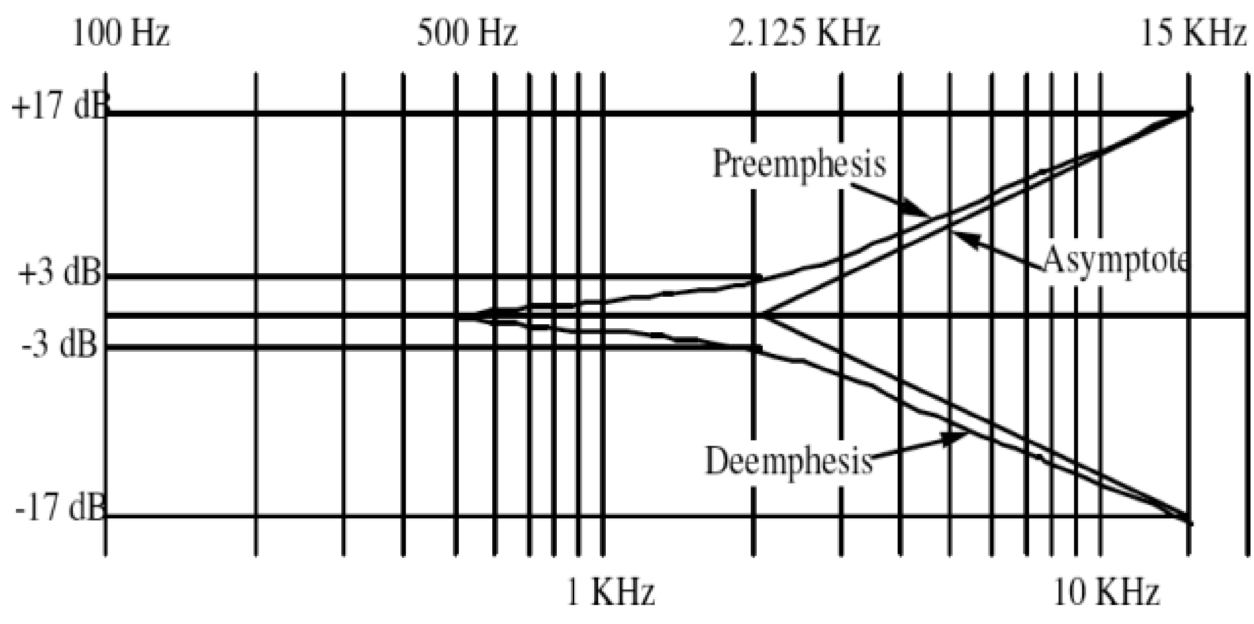
Table1: Pre-emphasis V_i = 20mV

Frequency(KHz)	Vo(mV)	Gain in dB(20 log V_o/V_i)

Table2: De-emphasis V_i = 5v

Frequency(KHz)	Vo(Volts)	Gain in dB(20 log V_o/V_i)

Graphs:



RESULT:

Thus, the effects of Pre-emphasis and De-emphasis was studied.

EXP. NO:4	SIGNAL SAMPLING
DATE:	

AIM:

To sample a signal with different sampling frequencies and to reconstruct the same..

APPARATUS REQUIRED:

S.No.	Name of the Equipment /Component	Range	Quantity
1.	Sampling trainer kit	-	1
2.	Connecting Plugs	-	-
3.	CRO	20 MHz	1

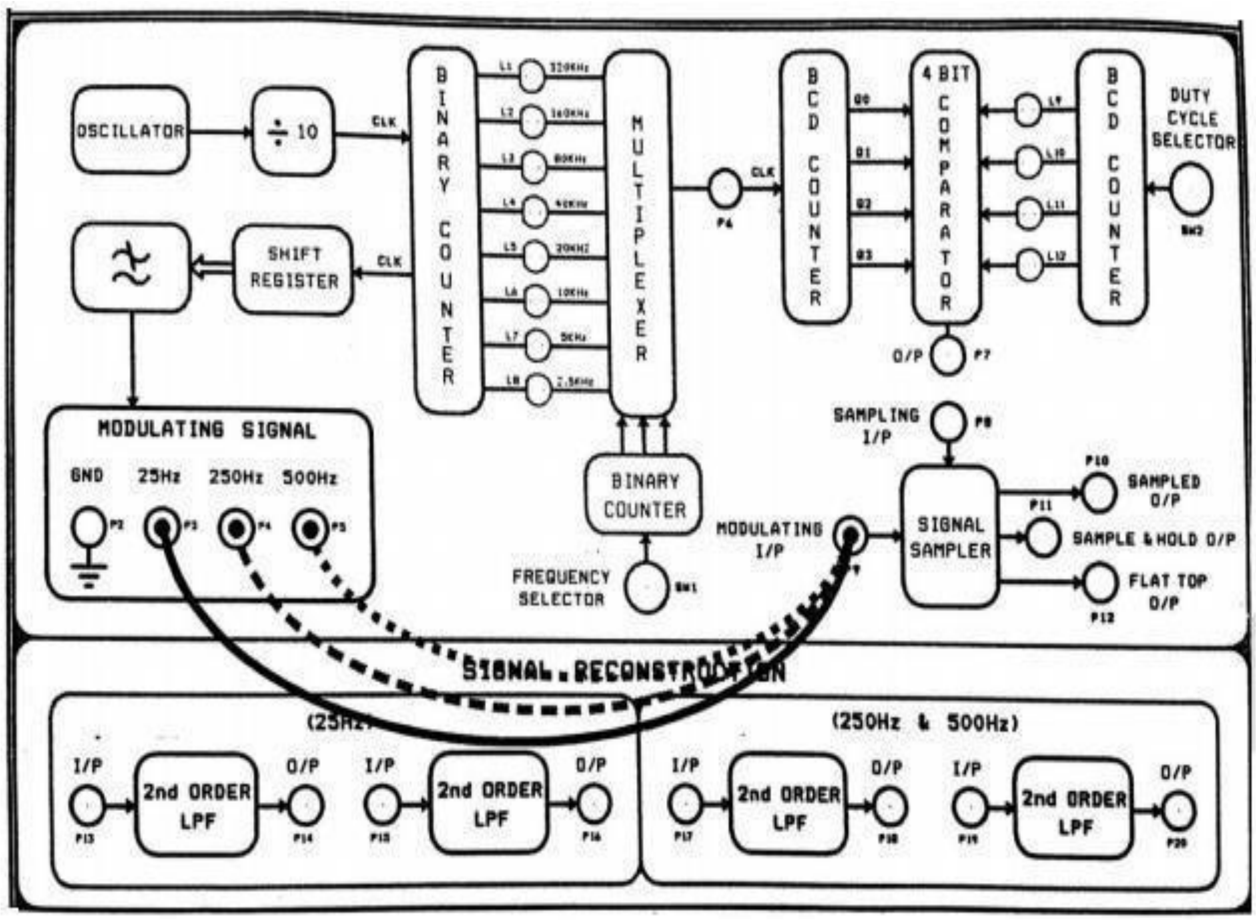
THEORY:

1. Sampling is the process by which an analog signal is converted into a corresponding sequence of samples that spaced uniformly in time (i.e. equally spaced in time).
2. It is necessary to choose the sampling rate property, so that the sequence of samples uniquely defines or recovers the original analog signal.
3. A band limited signal, which has no spectral components above the frequency fm Hz, is uniquely determined by its values at uniform intervals less than 1/2fm seconds apart.
4. The reciprocal of sampling period is called the sampling frequency or sampling rate (i.e) fs= 1/Ts. This ideal from of sampling is called "Instantaneous Sampling".
5. If the signal is sampled at an equal or uniform intervals it is known as "uniform sampling"

PROCEDURE:

1. The connections are given as per the circuit diagram.
2. Apply the modulating signal and measure its amplitude and time period.
3. Set the sampling frequency to 80 KHz and note down the amplitude and time period of the sampled signal.
4. Give the sampled signal to the reconstruction circuit and observe the reconstructed signal.
5. Repeat the same procedure for different sampling frequencies.
6. Plot the above waveforms in the graph.

SAMPING & RECONSTRUCTION BLOCK DIAGRAM:



TABULAR COLUMN:

SIGNAL	AMPLITUDE (V)	TIME PERIOD (ms)	FREQUENCY (KHz)
MODULATING SIGNAL			
CARRIER SIGNAL			

SAMPLED SIGNAL:

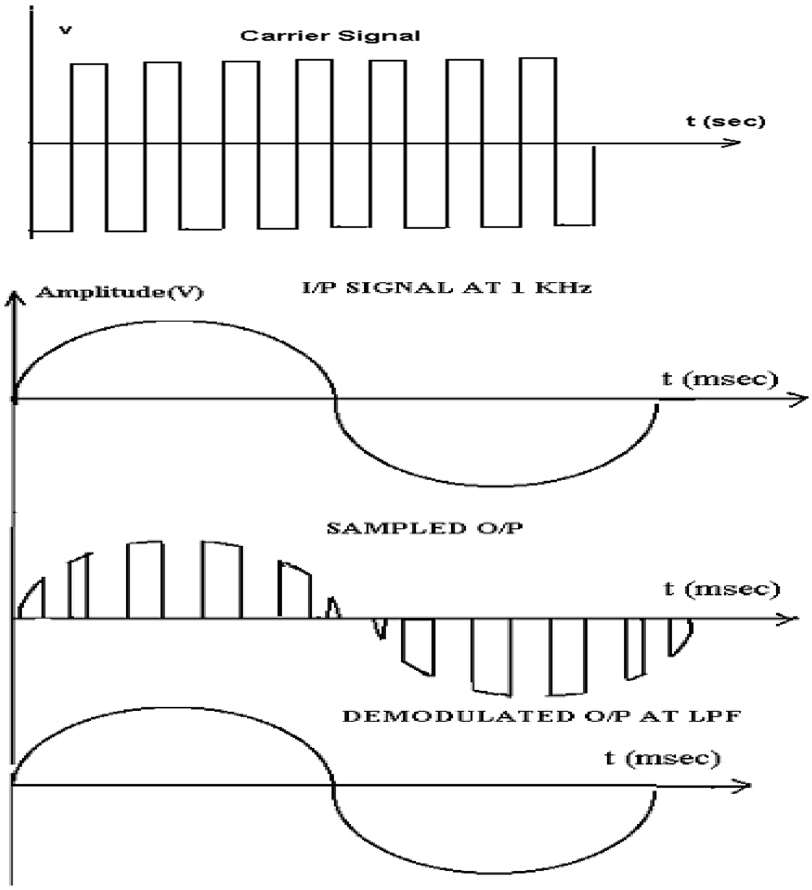
SIGNAL	AMPLITUDE (V)	TIME PERIOD(ms)		FREQUENCY (KHz)
		T_{ON}	T_{OFF}	
a) Sampled o/p b) Sample hold c) Flat top sample				

RECONSTRUCTED SIGNAL:

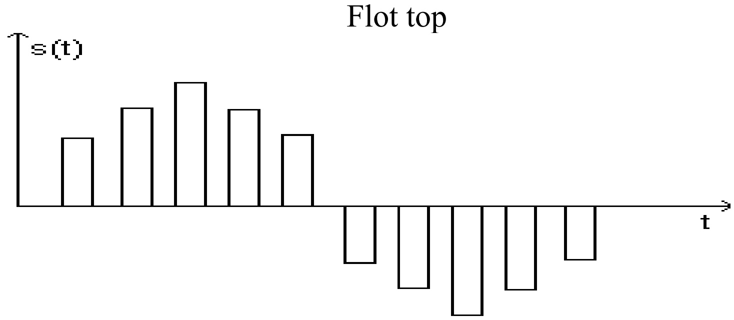
AMPLITUDE (V)	TIME PERIOD (ms)	FREQUENCY (KHz)

Duty cycle calculation: D = Ton / (Ton + Toff) =----------- %

MODEL GRAPH:



Flot top



RESULT:

Thus the given signal is sampled with different sampling frequencies and the waveforms are plotted.

EXP.NO: 5	TIME DIVISION MULTIPLEXING (TDM)
DATE:	

AIM:

To construct and study the TDM Circuit and draw its waveforms.

APPARATUS REQUIRED:

S.No.	Name of the Equipment /Component	Range	Quantity
1.	TDM Trainer Kit	-	1
2.	Connecting Plugs	-	-
3.	CRO	20 MHz	1

THEORY:

Multiplexing is the process of transmitting several separate information channels over the same communication circuit simultaneously without interference.

In PAM, PPM the pulse is present for a short duration and for most of the time between the two pulses no signal is present. This free space between the pulses can be occupied by pulses from other channels. This is known as Time Division Multiplexing. Thus, time division multiplexing makes maximum utilization of the transmission channel.

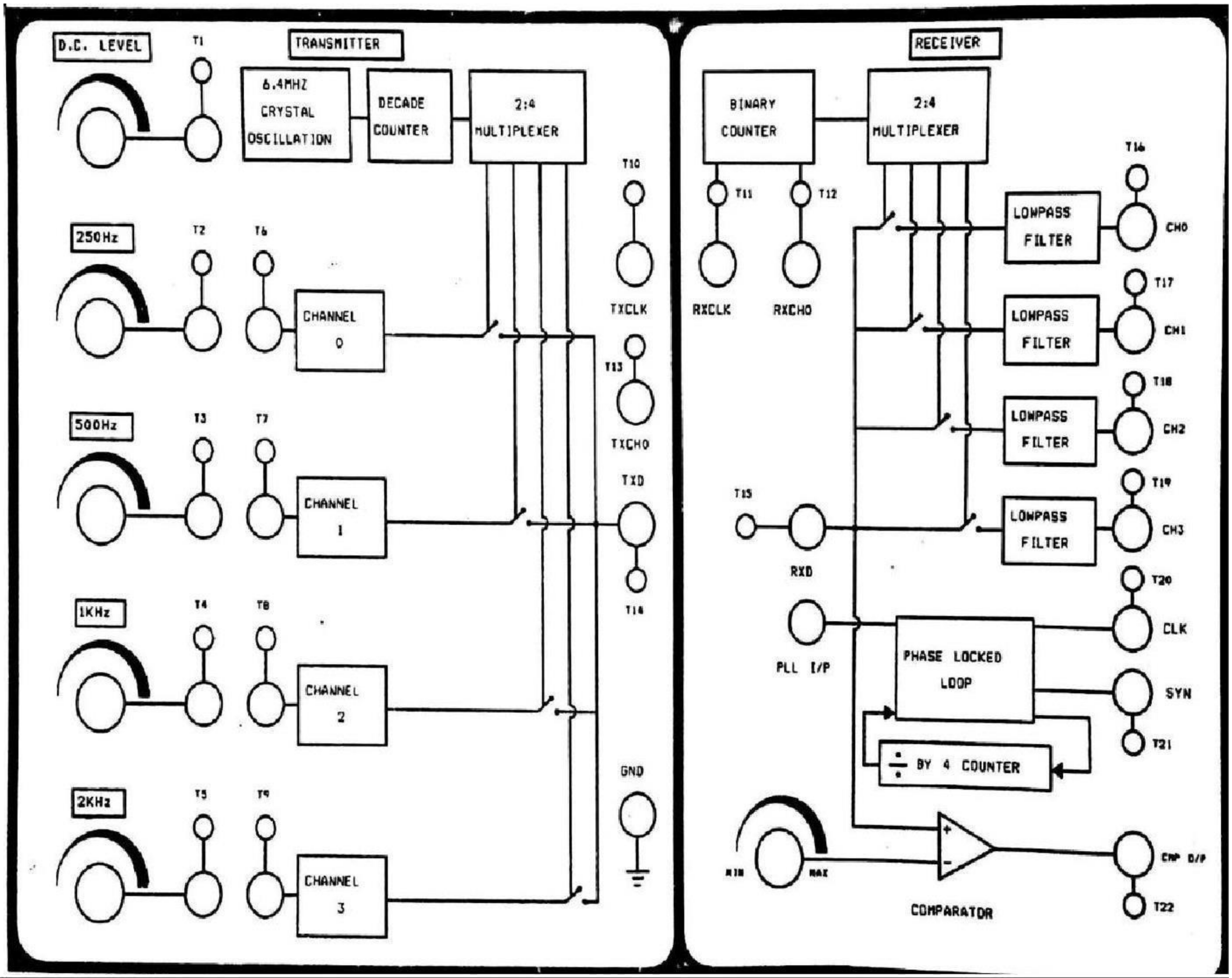
In TDM several information channels are transmitted over the same communication circuit simultaneously using a time-sharing technique. As an example, PAM waveforms can be generated, that have a very low duty cycle. This means the single channel is transmitted. Most of the transmission time would be wasted. Instead, this time is fully utilized by transmitting pulse other than PAM signals during the intervals.

The first pulse is a synchronizing pulse with is used at the receiver in demultiplexing. The second pulsein amplitude modulated by channel 1. The third by channel 2 and the fourth by channel 3. This set up impulse is called a frame. The primary advantage of TDM is that several channels of information can be transmitted over a single cable of a single radio transmitter as any other communication circuit. Also, any type of pulse modulator may be used in the TDM. In fact, many telephone systems are PCM-TDM

PROCEDURE:

1. Give the connections as per the block diagram.
2. Apply the four input sinusoidal signals of different frequency to four channels and measure the amplitude and time period of each signal.
3. Observe and measure the amplitude and frequency of the sampled signal for each channel individually.
4. Then observe the multiplexed waveform in the CRO.
5. Apply the multiplexed signal to the demultiplexer circuit and observe the original signals transmitted.
6. Measure the amplitude and time period of demultiplexed signal for each channel individually.
7. Plot all the waveforms in the graph.

BLOCK DIAGRAM:



TABULAR COLUMN

2. Transmitted signals

Channel	Amplitude (V)	Time Period (ms)	Frequency (KHz)

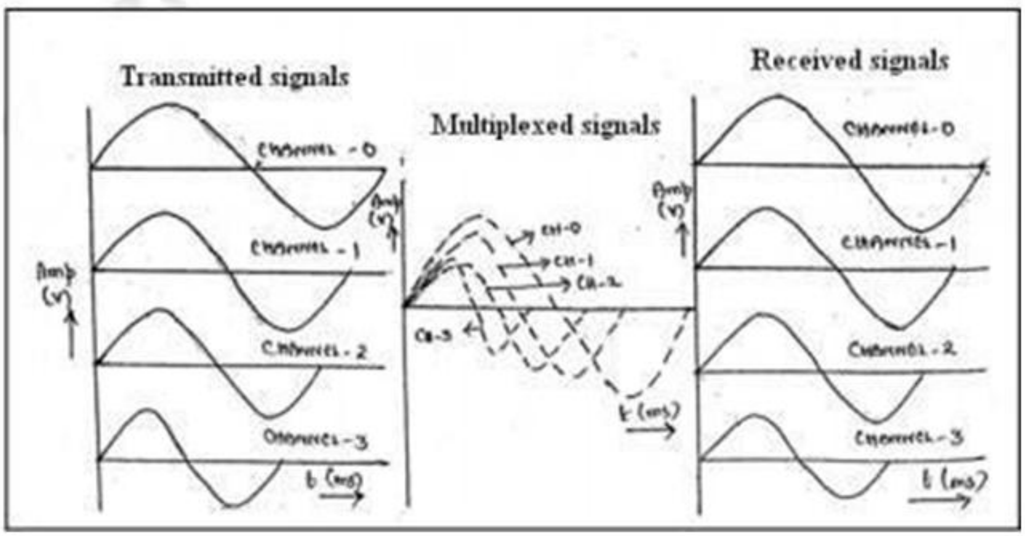
3. Received Signals

Channel	Amplitude (V)	Time Period (ms)	Frequency (KHz)

3. Sampled Signal

Channel	**Amplitude (V)**	**No. of Samples**	**Time Period (ms) (for each sample)**		**Total Time Period (ms)**	**Frequency (KHz)**
			T_{ON}	**T_{OFF}**		

<u>MODEL GRAPH:</u>



<u>RESULT:</u>

Thus, the Time division multiplexing and demultiplexing waveforms are obtained.

EXP. NO:6	PULSE CODE MODULATION & DEMODULATION
DATE:	

Aim:

To construct and study a PCM transmitter and receiver kit

Apparatus Required:

1. PCM Transmitter and Receiver Kit
2. Connecting Plugs
3. CRO

THEORY:

Pulse code modulation is known as digital pulse modulation technique. It is the process in which the message signal is sampled and the amplitude of each sample is rounded off to the nearest one of the finite set of allowable values. It consists of three main parts transmitter, transmitter path and receiver. The essential operation in the transmitter of a PCM system are sampling, Quantizing and encoding. The band pass filter limits the frequency of the analog input signal. The sample and hold circuit periodically samples the analog input signal and converts those to a multi-level PAM signal. The ADC converts PAM samples to parallel PCM codes which are converted to serial binary data in parallel to serial converter and then outputted on the transmission line as serial digital pulse. The transmission line repeaters are placed at prescribed distance to regenerate the digital pulse.

In the receiver serial to parallel converter converts serial pulse received from the transmission line to parallel PCM codes. The DAC converts the parallel PCM codes to multi-level PAM signals. The hold circuit is basically a Low Pass Filter that converts the PAM signal back to its original analog form.

1. The kit diagram shows the method of PCM generation system.
2. In this transmitter circuit, two message inputs are sampled and multiplexed and then it is pass over to the A/D converter to circuit to get digital messages as encoder.
3. The PCM system has an error check code generator to make a distortion less transmission.
4. Then to a shift register to get the regenerated signals without any error.
5. The timing circuit / logic provides a periodic pulse train, derived from receiver sampling the equalized pulses at the instants of time where the signal to noise ration is minimum.
6. If the measured value is larger than threshold or reference value, a ‘1’ was transmitted.
7. If the comparison value is below the threshold value a zero was transmitted.
8. The reverse steps are used in the receiver process.

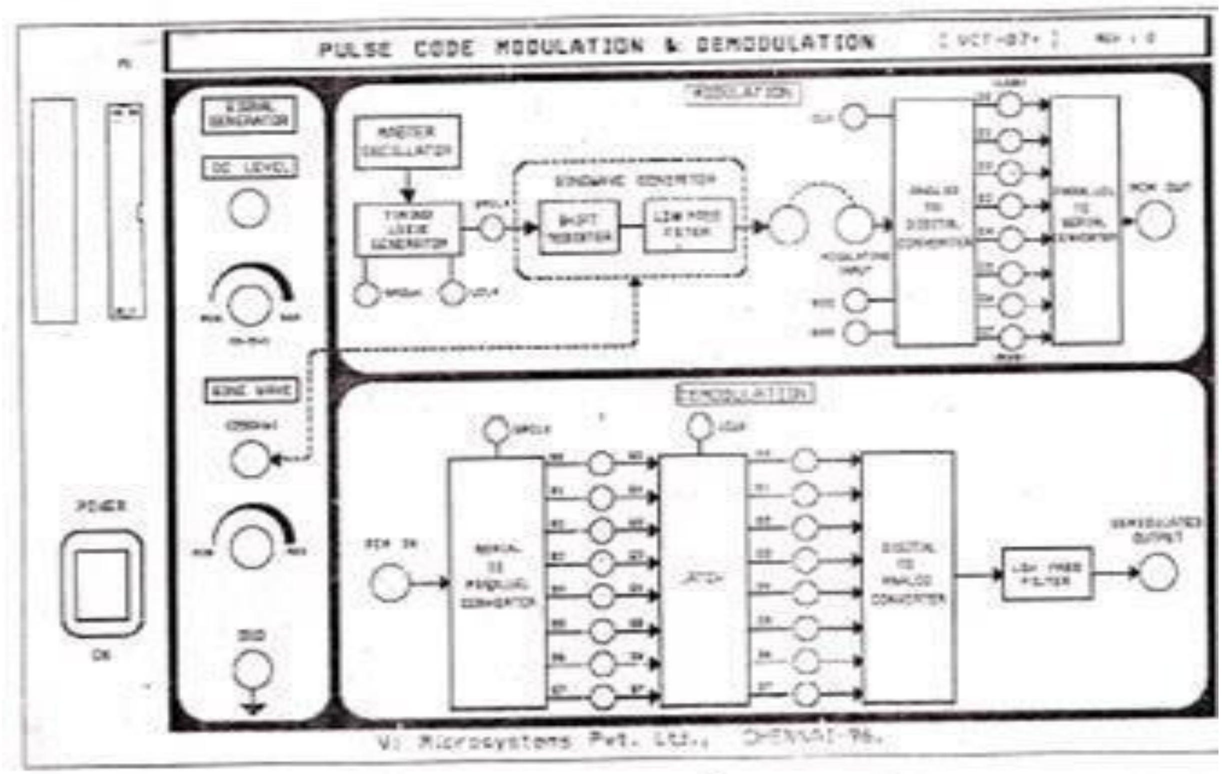
ADVANTAGES:

1. Secrecy
2. Noise resistant and hence free from channel interference

PROCEDURE:

1. Give the connections as per the block diagram.
2. Measure the amplitude and time period of the input signal.
3. Measure the amplitude and time period of the sampled signal.
4. Apply the input signal to the PCM kit and observe and measure the PCM output.
5. Plot the waveforms in the graph..

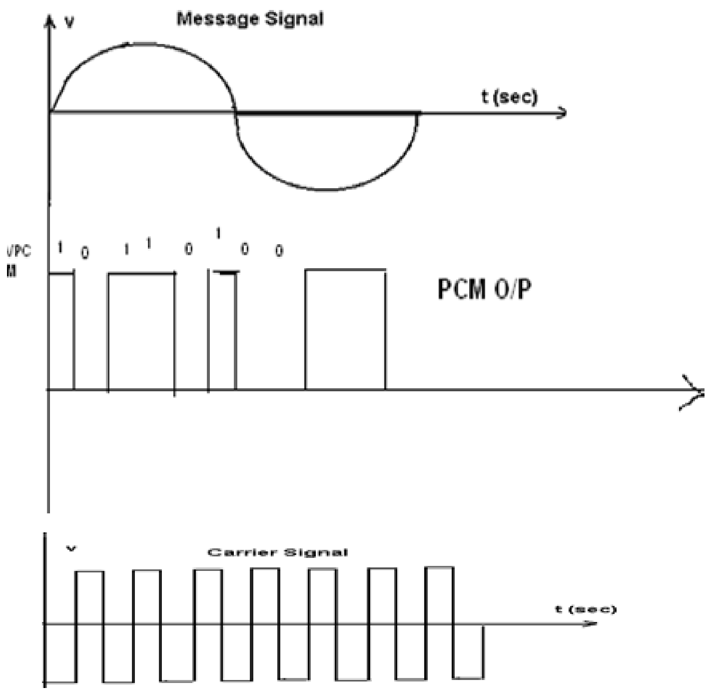
PCM TRANSMITTER& RECEIVER



Tabular Column:

SIGNAL	AMPLITUDE (V)	TIME PERIOD (ms)	FREQUENCY (KHz)
MODULATING SIGNAL			
CARRIER SIGNAL			
PCM CODE			

Model Graph :



Result:

The PCM output waveforms are studied and obtained.

EXP. NO:7	PULSE AMPLITUDE MODULATION & DEMODULATION
DATE:	

Aim:

To generate the Pulse Amplitude modulated and demodulated signals

Apparatus required:

Name of the Apparatus	Specifications/Range	Quantity
Resistors	1KΩ, 10KΩ, 100KΩ, 5.8KΩ, 2.2KΩ,	Each one
Transistor	BC 107	2
Capacitor	10μF, 0.001μF	each one
CRO	30MHz	1
Function generator	1MHz	1
Regulated Power Supply	0-30V,1A	1
CRO Probes	---	1

Theory:

PAM is the simplest form of data modulation. The amplitude of uniformly spaced pulses is varied in proportion to the corresponding sample values of a continuous message m (t). A PAM waveform consists of a sequence of flat-topped pulses. The amplitude of each pulse corresponds to the value of the message signal x (t) at the leading edge of the pulse. The pulse amplitude modulation is the process in which the amplitudes of regularity spaced rectangular pulses vary with the instantaneous sample values of a continuous message signal in a one-one fashion.

PAM is of two types

1) Double polarity PAM ==> This is the PAM wave which consists of both positive and negative pulses .s

2) Single polarity PAM ==> This consists of PAM wave of only either negative (or) Positive pulses. In this the fixed dc level is added to the signal to ensure single polarity signal.

Waveforms

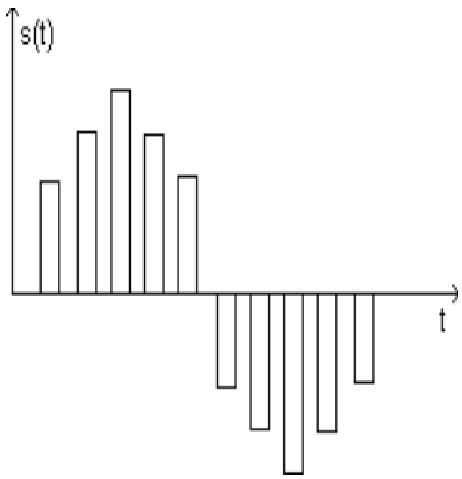


Fig. Bipolar PAM signal

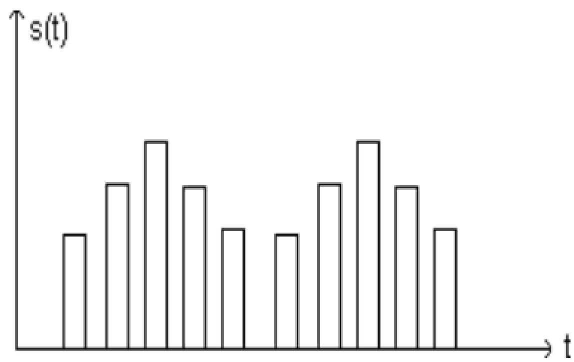


Fig. Single polarity PAM

Circuit Diagram:

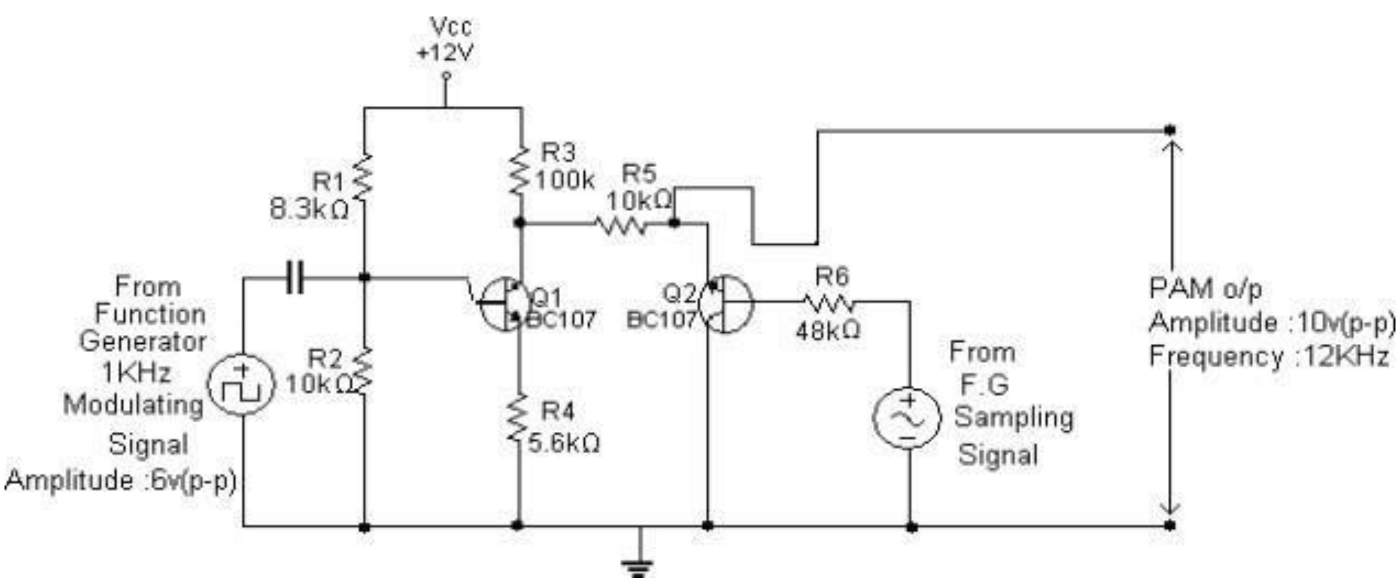


Fig 1. Pulse Amplitude Modulation Circuit

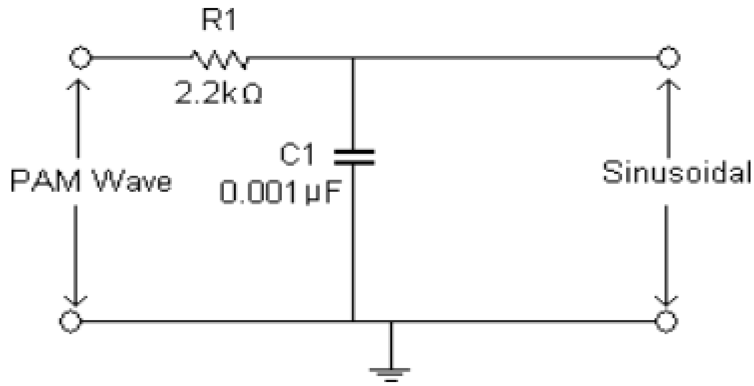


Fig 2. Pulse Amplitude Demodulation Circuit

Procedure:

1. Connect the circuit as per the circuit diagram shown in the fig 1
2. Set the modulating frequency to 1KHz and sampling frequency to 12KHz
3. Observe the o/p on CRO i.e. PAM wave.
4. Measure the levels of Emax & Emin.
5. Feed the modulated wave to the low pass filter as in fig 2.
6. The output observed on CRO will be the demodulated wave.
7. Note down the amplitude (p-p) and time period of the demodulated wave. Vary the amplitude and frequency of modulating signal. Observe and note down the changes in output.
8. Plot the wave forms on graph sheet.

Observations:

S.No	Signal	Amplitude	Time

Result:

The Pulse Amplitude Modulation circuit is constructed and its output waveform is plotted.

EXP. NO:8	PULSE WIDTH MODULATION AND DEMODULATION
DATE:	

Aim:

To generate the pulse width modulated and demodulated signals

Apparatus required:

Name of the Apparatus	Specifications/Range	Quantity
Resistors	1.2kΩ, 1.5 kΩ, 8.2 kΩ	1,1,2
Capacitors	0.01 μF, 1 μF	2,2
Diode	0A79	1
CRO	0-30, MHz	1
Function Generator	1MHz	1
RPS	0-30v,1A	1
IC 555	Operating tem :SE 555 -55°C to 125°C NE 555 0° to 70°C Supply voltage :+5V to +18V Timing :μSec to Hours Sink current :200mA Temperature stability :50 PPM/°C change in temp or 0-005% /°C.	1
CRO Probes	--	1

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. It is also called Pulse Duration Modulation.

Circuit Diagram:

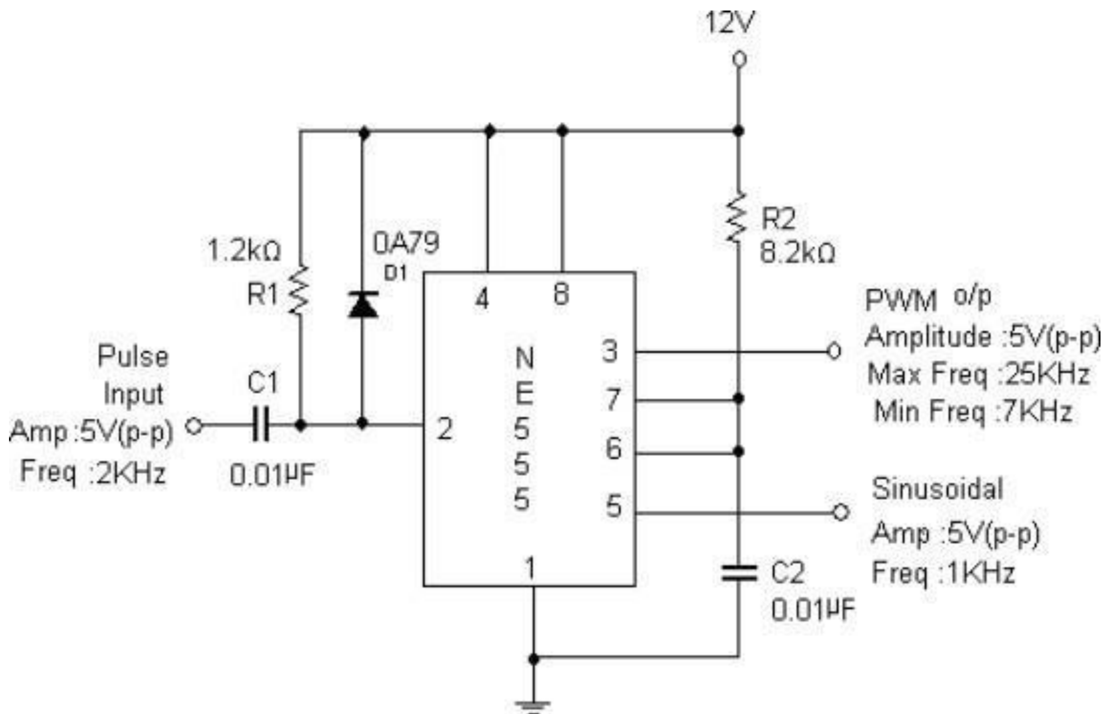


Fig: 1 Pulse Width Modulation Circuit

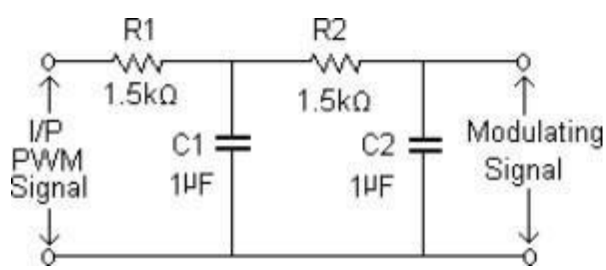


Fig: 2 Demodulation Circuit

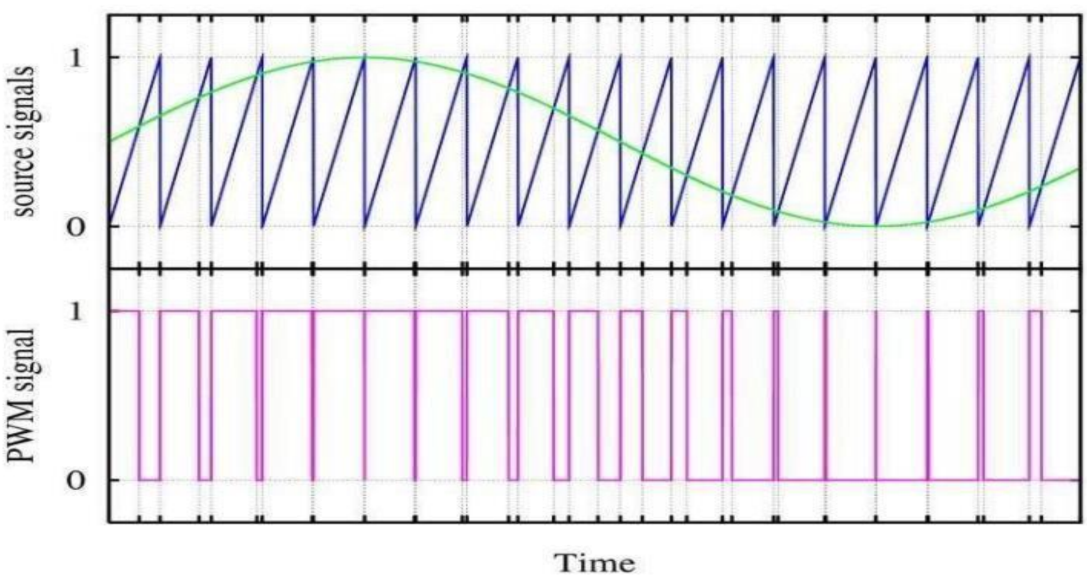
Procedure:

1. Connect the circuit as per circuit diagram shown in fig 1.
2. Apply a trigger signal (Pulse wave) of frequency 2 KHz with amplitude of 5v (p-p).
3. Observe the sample signal at the pin3.
4. Apply the ac signal at the pin 5 and vary the amplitude
5. Note that as the control voltage is varied output pulse width is also varied.
6. Observe that the pulse width increases during positive slope condition & decreases under negative slope condition. Pulse width will be maximum at the +ve peak and minimum at the –ve peak of sinusoidal waveform. Record the observations.
7. Feed PWM waveform to the circuit of Fig.72 and observe the resulting demodulated waveform.

Observations:

S.No.	Control voltage (V_{P-P})	Output pulse width (m sec)

Waveforms



Result:

The Pulse Width Modulation circuit is constructed and its output waveform is plotted.

EXP. NO:9	PULSE POSITION MODULATION & DEMODULATION
DATE:	

Aim: To generate pulse position modulation and demodulation signals and to study the effect of amplitude of the modulating signal on output

Apparatus required:

Name of the apparatus	Specifications/Range	Quantity
Resistors	3.9kΩ, 3kΩ, 10kΩ, 680kΩ	Each one
Capacitors	0.01µF, 60µF	2,1
Function Generator	1MHz	1
RPS	0-30v,1A	1
CRO	0-30MHz	1
IC 555	Operating tem :SE 555 -55°C to 125°C NE 555 0° to 70°C Supply voltage :+5V to +18V Timing :µSec to Hours Sink current :200mA Temperature stability :50 PPM/°C change in temp or 0-005% /°C.	1
CRO Probes	----	1

Theory: In Pulse Position Modulation, both the pulse amplitude and pulse duration are held constant but the position of the pulse is varied in proportional to the sampled values of the message signal. Pulse time modulation is a class of signaling techniques that encodes the sample values of an analog signal on to the time axis of a digital signal and it is analogous to angle modulation techniques. The two main types of PTM are PWM and PPM. In PPM the analog sample value determines the position of a narrow pulse relative to the clocking time. In PPM rise time of pulse decides the channel bandwidth. It has low noise interference.

Circuit Diagram:

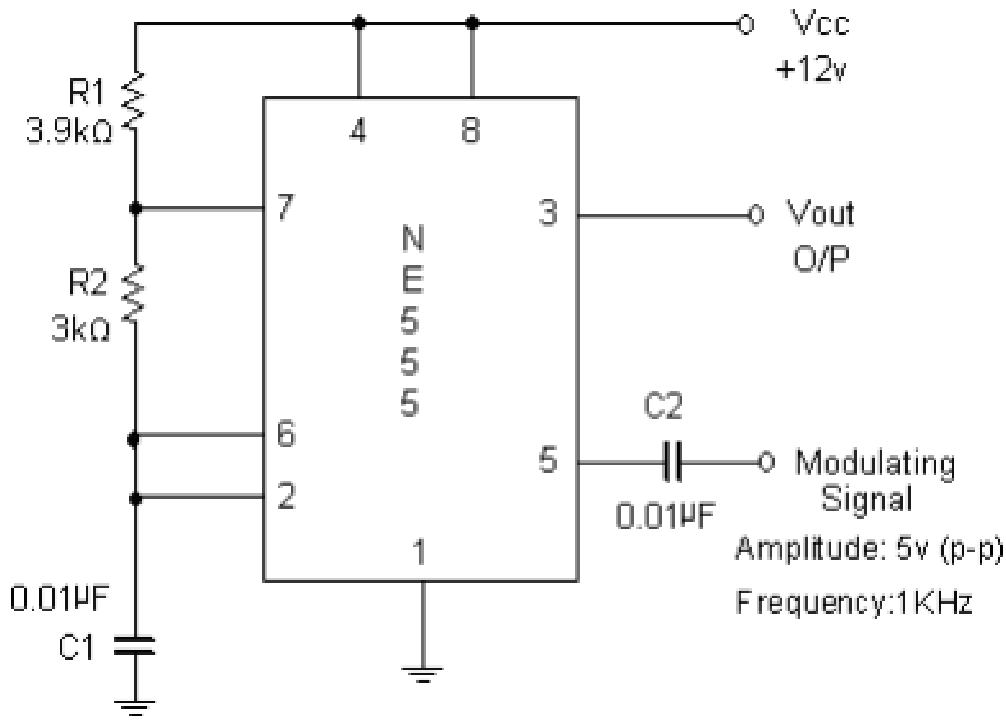


Fig: 1 Pulse Position Modulation Circuit

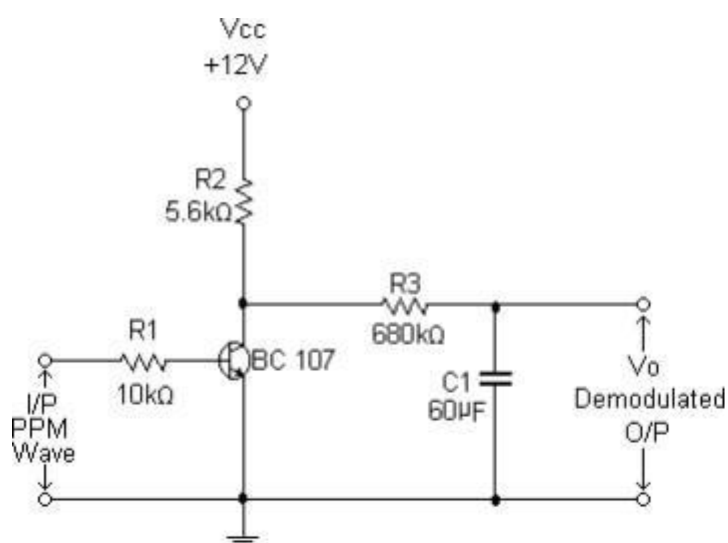


Fig: 2 Demodulation Circuit

Procedure:

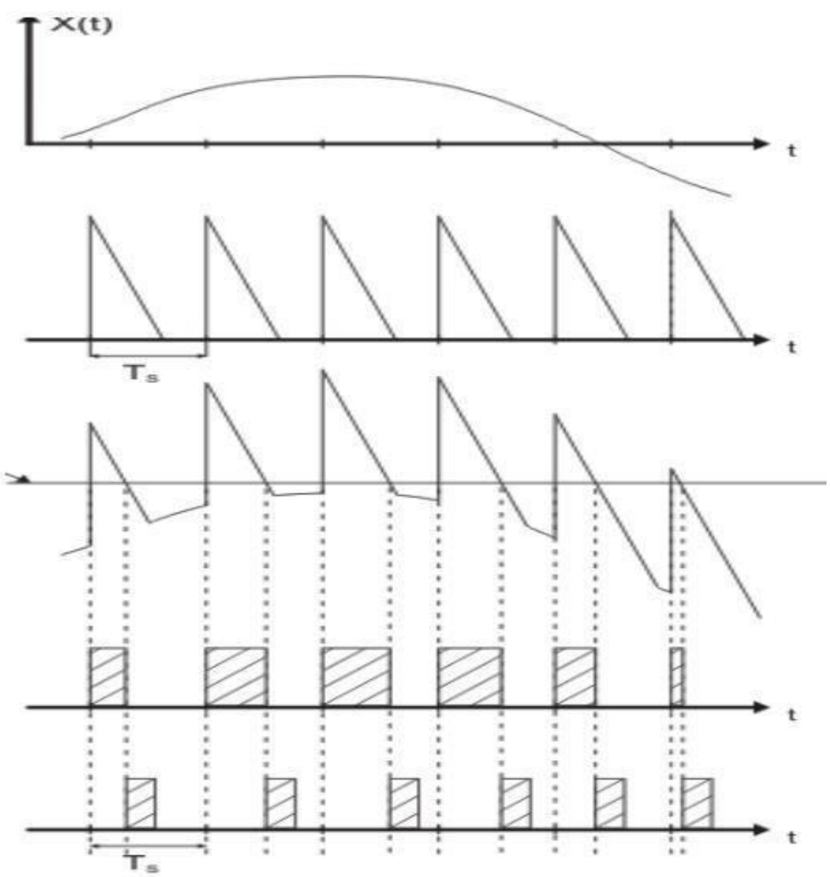
1. Connect the circuit as per circuit diagram as shown in the fig 1.
2. Observe the sample output at pin 3 and observe the position of the pulses on CRO and adjust the amplitude by slightly increasing the power supply. Also observe the frequency of pulse output.
3. Apply the modulating signal, sinusoidal signal of 2V (p-p) (ac signal) 2v (p-p) to the control pin 5 using function generator.

4. Now by varying the amplitude of the modulating signal, note down the position of the pulses.
5. During the demodulation process, give the PPM signal as input to the demodulated circuit as shown in Fig2.
6. Observe the o/p on CRO.
7. Plot the waveform.

Observations:

Modulating signal Amplitude(V_{p-p})	Time period(ms)		Total Time period(ms)
	Pulse width ON (ms)	Pulse width OFF (ms)	

Waveforms:



Result:

The Pulse Position Modulation circuit is constructed and its output waveform is plotted.

EXP. NO:10	Amplitude Shift Keying & Frequency Shift Keying
DATE:	

AIM:- To plot the wave form for Binary Amplitude Shift Keying (BASK) signal and Binary Frequency Shift Keying (BFSK) signal for a stream of bits.

Apparatus Required:

1. ASK & FSK Modulation and demodulation kit
2. Connecting Plugs
3. CRO

Theory

Amplitude Shift Keying – ASK In this form of modulation the sine carrier takes 2 amplitude values, determined by the binary datasignal. Usually the modulator transmits the carrier when the data bit is "1", it completely removes itwhen the bit is "0" (fig 2.1). There are also ASK shapes called "multi-level", where the amplitude ofthe modulated signal takes more than 2 values. The demodulation can be coherent or non-coherent. In the first case, more complex as concerns thecircuits but more effective as against the noise effect, a product demodulator multiplies the ASKsignal by the locally regenerated carrier. In the second case the envelope of the ASK signal isdetected via diode. In both cases the detector is followed by a low pass filter, which removes theresidual carrier components, and a threshold circuit which squares the data signal

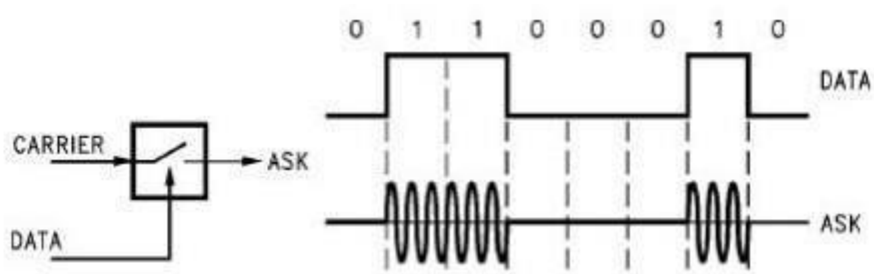
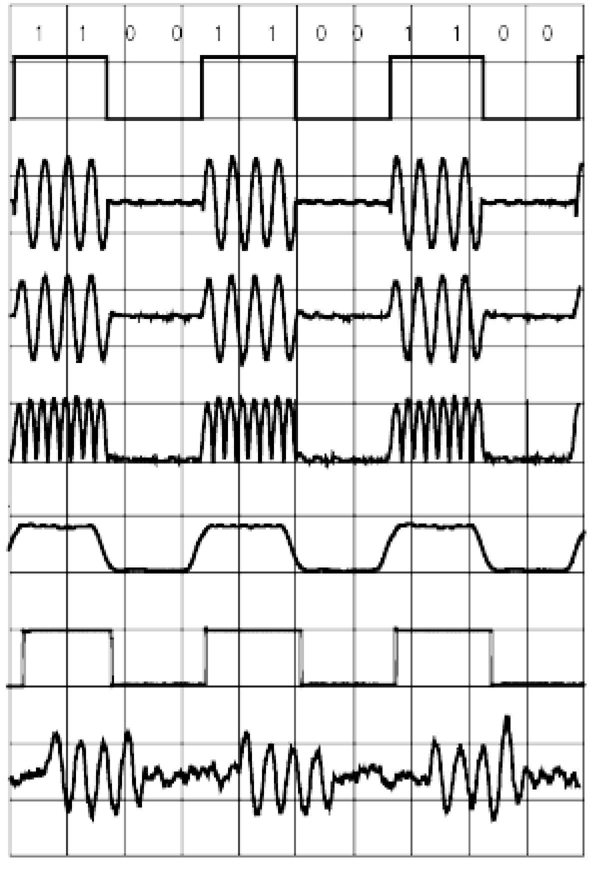
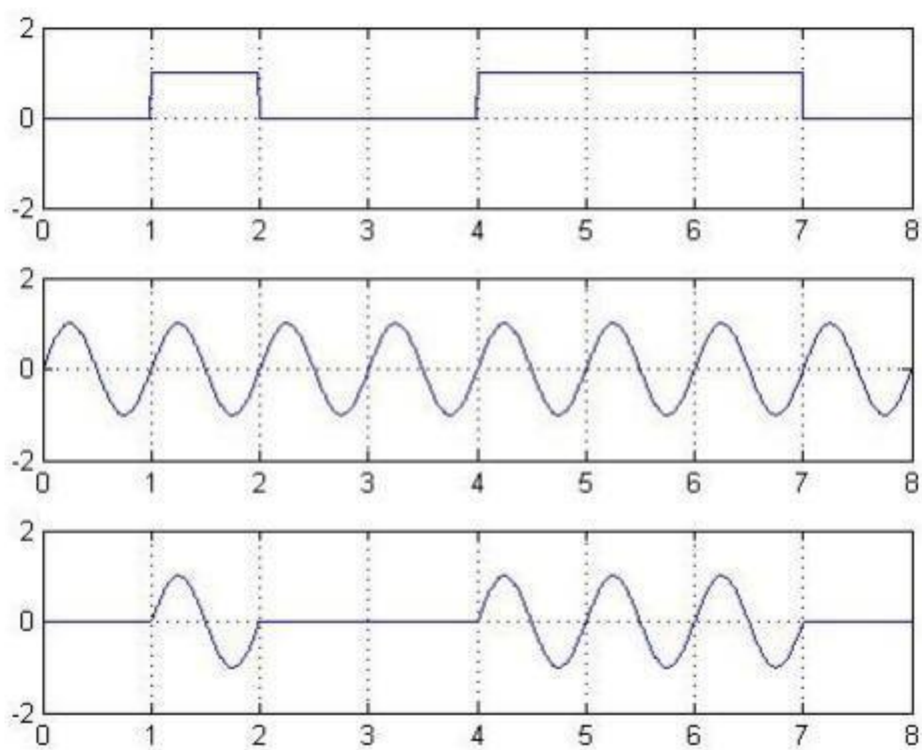


Fig 1: ASK Modulation



OBSERVATION:- Output waveform for the bit stream [0 1 0 0 1 1 1 0]

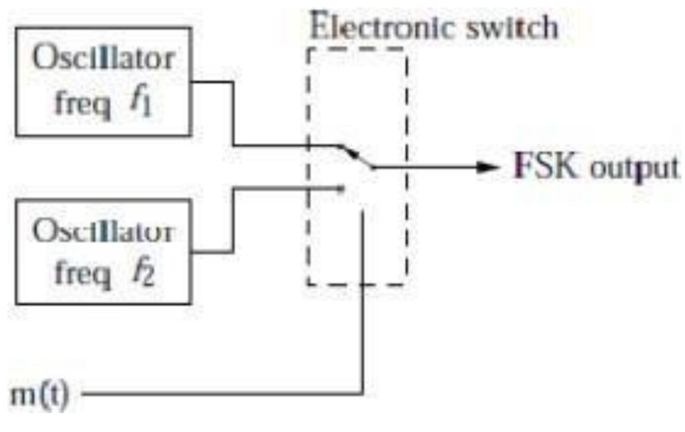


Frequency Shift Keying

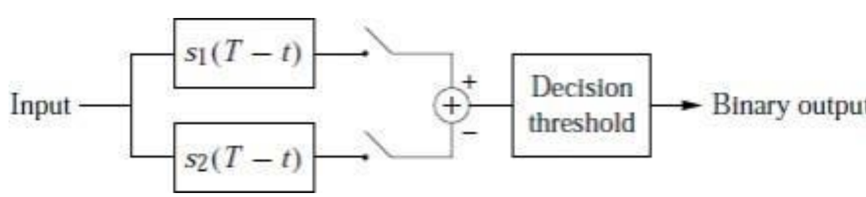
THEORY:- In frequency-shift keying, the signals transmitted for marks (binary ones) and spaces (binary zeros) are respectively.

$$s_1(t) = A\cos(\omega_1 t + \theta_c), \qquad 0 < t \leq T$$
$$s_2(t) = A\cos(\omega_2 t + \theta_c), \qquad 0 < t \leq T$$

This is called a discontinuous phase FSK system, because the phase of the signal is discontinuous at the switching times. A signal of this form can be generated by the following system.

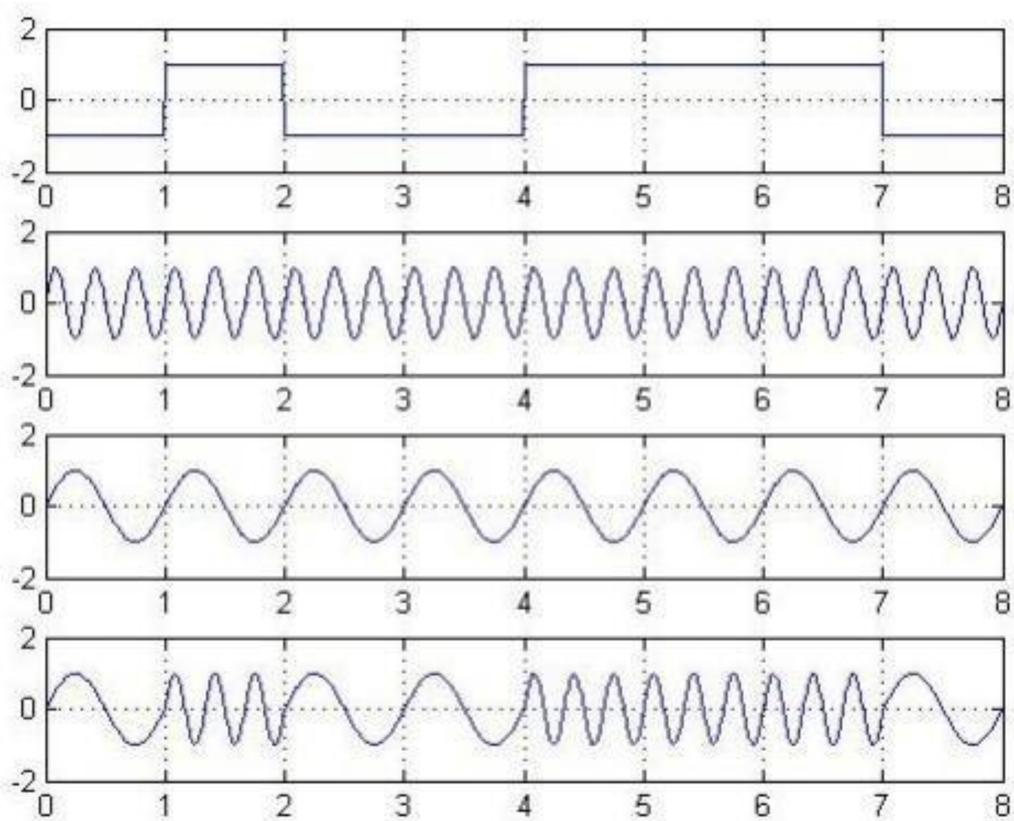


If the bit intervals and the phases of the signals can be determined (usually by the use of a phaselock loop), then the signal can be decoded by two separate matched filters



OBSERVATION:-

Output waveform for the bit stream [0 1 0 0 1 1 1 0]



Result:

Thus the wave form for Binary Amplitude Shift Keying (BASK) signal and Binary Frequency Shift Keying (BFSK) signal for a stream of bits was observed .

EXP. NO:11	Phase Shift Keying (PSK)
DATE:	

AIM:- To plot the wave form for Binary Phase Shift Keying (BFSK) signal for a stream of bits.

Apparatus Required:

1. PSK Modulation and demodulation kit
2. Connecting Plugs
3. CRO

THEORY

In this kind of modulation, the sine carrier takes 2 or more phase values, directly determined by the binary data signal (2-phase modulation) or by the combination of a certain number of bits of the same data signal(N-phase modulation). In 2-phase PSK modulation, called 2-PSK, or Binary PSK (BPSK), or Phase Reversal Keying (PRK), the sine carrier takes 2 phase values, determined by the binary data signal (fig.1). A modulation technique is the one using a balanced modulator. The output sine-wave of the modulator is the direct or inverted (i.e.shifted of 180°) input carrier, as function of the data signal. Constellation Diagram The modulation states of the PSK Modulator are represented with points in a vectorial diagram. Each point is a modulation state, characterized by a phase and an amplitude. This representation is called constellation diagram, or more simply constellation.

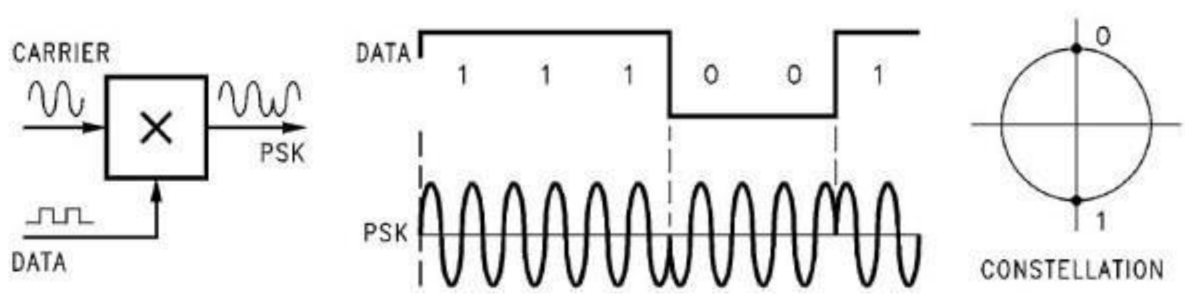


Figure 1: PSK Modulation

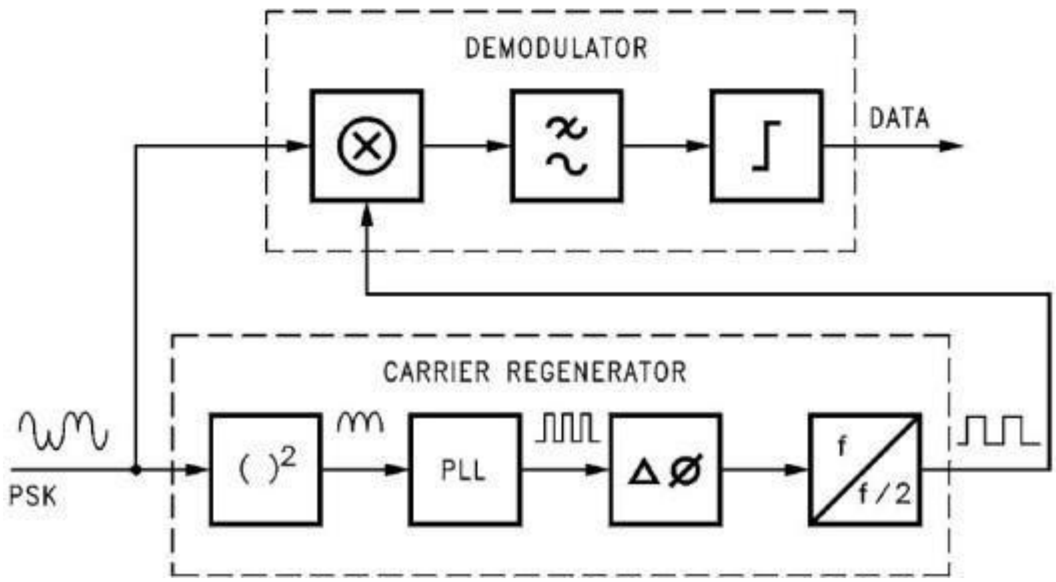
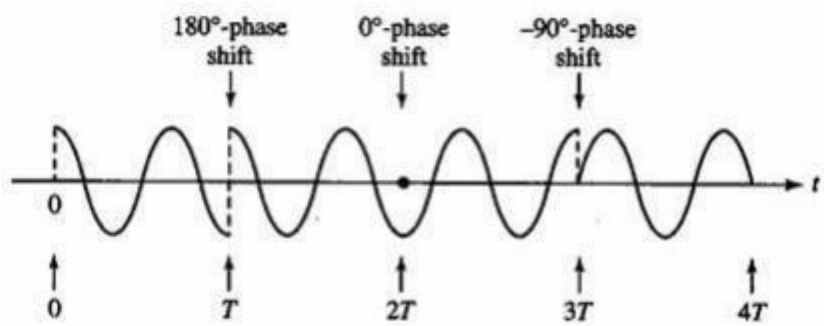
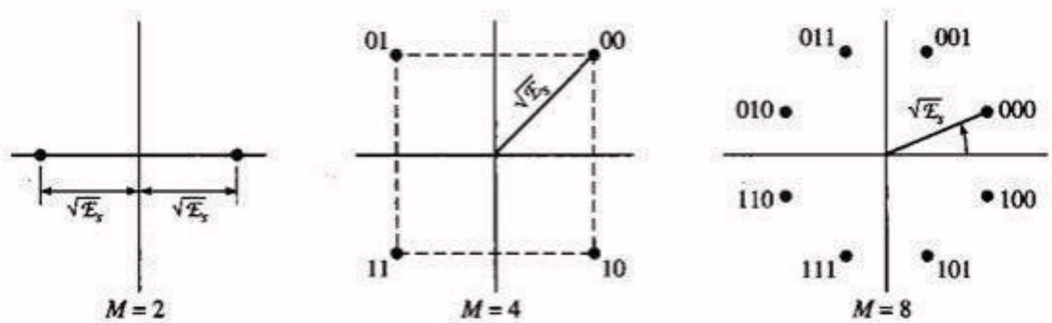


Figure 2: PSK Demodulation with carrier regenerator with quadratic law

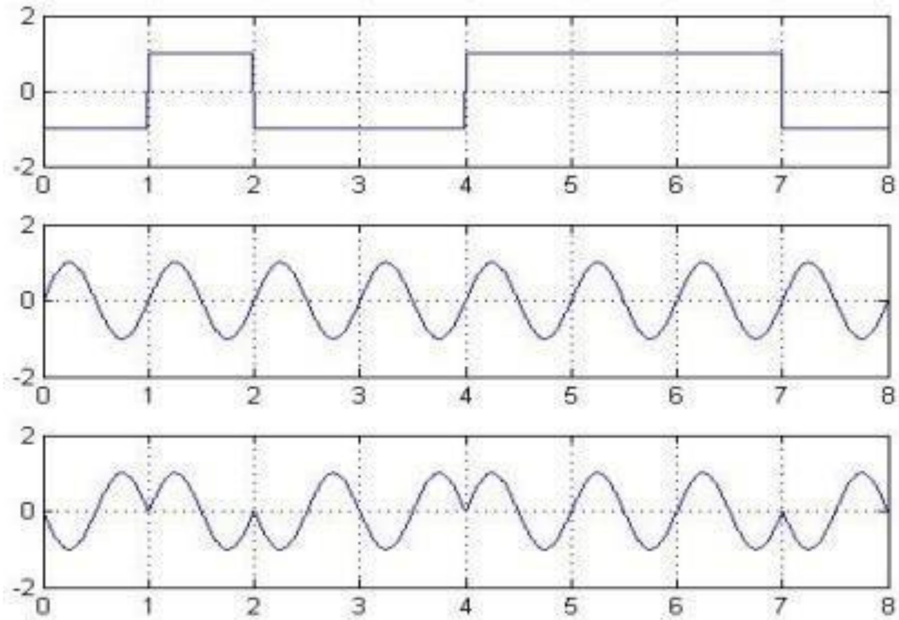


Example of a four-phase PSK signal



PSK signal constellations

OBSERVATION:- Output waveform for the bit stream [0 1 0 0 1 1 1 0]



Result:

Thus the wave form for Binary Phase Shift Keying (BPSK) signal for a stream of bits was observed .

EXP. NO:12	DELTA MODULATION AND DEMODULATION
DATE:	

Aim:

To construct and study the characteristics of Delta modulation and demodulation kit.

Apparatus Required:

4. DELTA Modulation and demodulation kit
5. Connecting Plugs
6. CRO

THEORY

Delta modulation is a form of pulse modulation width a sample value is represented as a signal bit. Thisis almost similar to differential PCM,as the transmitted

Bit is only, one per sample first to indicate whether the present sample is larger or smaller than previous oneThe encoding decoding, and quantizing process become extremely simple bit this system cannot handle rapidly varying samples. This increases the quantizing noise. The trainer is a self sustained and well organized kit.

ADVANTAGES:

- Simple system/circuitry
- Cheap
- Single bit encoding allows us to increase the sampling rate or to transmit more information at somesampling rate for the given system BW.

DISADVANTAGE :

- Noise and distortion.
- Major drawback is that it is unable to pass DC information.

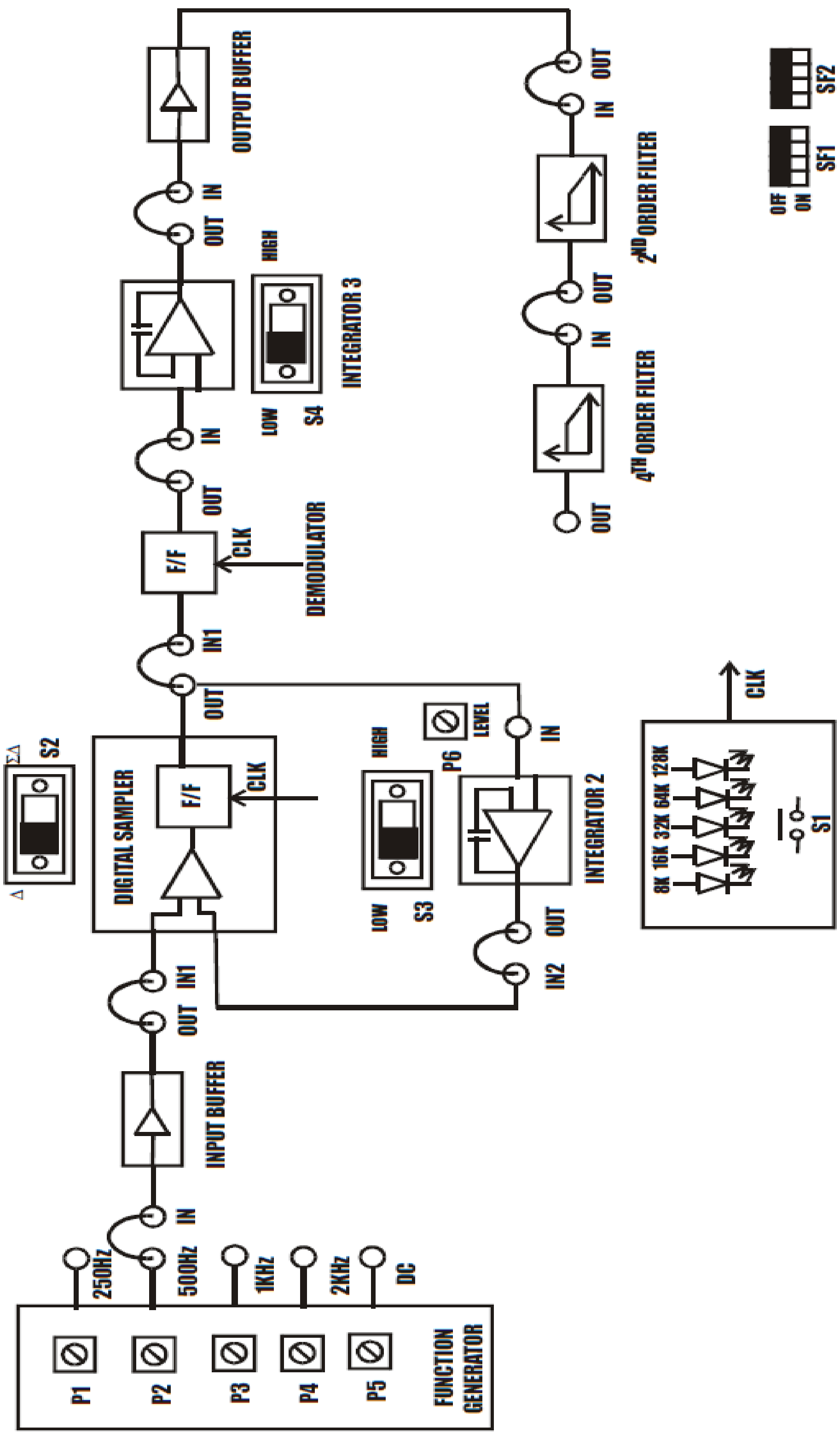
APPLICATION:

- Digital voice storage
- Voice transmission
- Radio communication devices such TV remotes

PROCEDURE:

1. Connections are to be given as per the block diagram.
2. Observe the modulated waveforms.
3. Measure the amplitude and time period of both the waveforms.
4. Plot the graph.
5. Repeat the above procedure for delta modulation also

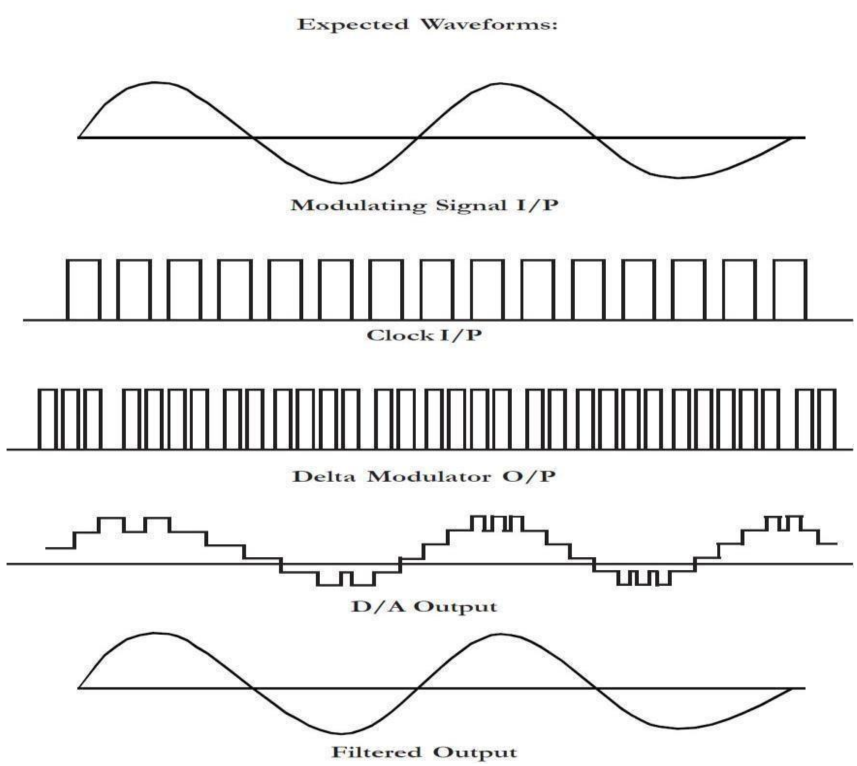
BLOCK DIAGRAM FOR DELTA MODULATION AND DEMODULATION



TABULATION

WAVE	AMPLITUDE	TIME PERIOD	FREQUENCY
INPUT			
LPF OUTPUT			
COMPARATOR O/P			
ONE BIT QUANTISERO/P			
BIPOLAR NRZ ENCODER O/P			
DEMODULATED			

MODELGRAPH



RESULT

The delta modulation demodulation circuit is constructed and its output waveform is plotted.

EXP. NO: 13	SIMULATION OF ASK GENERATION AND DETECTION SCHEMES
DATE:	

AIM:

To perform ASK,FSK and PSK generation using MATLAB program.

SOFTWARE REQUIRED:

- MATLAB

ALGORITHM:

STEP 1: Start the program.

STEP 2: GET the two signals

STEP 3: Perform ASK,BFSK,BPSK

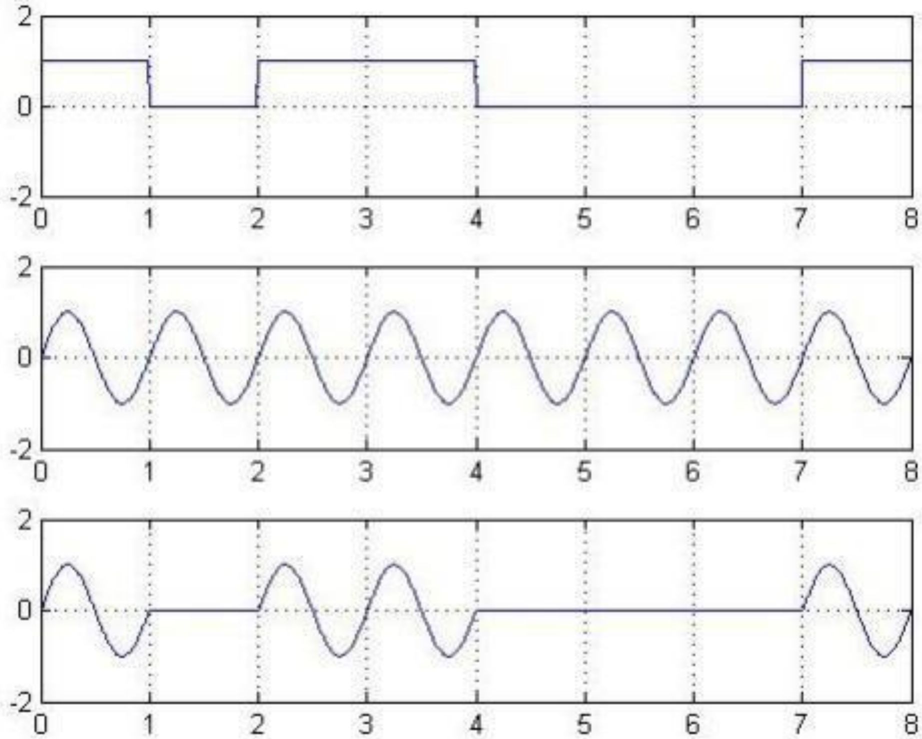
STEP 4: Plot the time along x-axis and amplitude along y-axis.

STEP 5: Stop the program.

ASK PROGRAM:

```
clc;
t=0:0.0001:0.15;
m = square(2*pi*10*t);
c = sin(2*pi*60*t);
y1=(m.*c);
for i = 1:1500
if(m(i)==1)
y1(i) = c(i);
else
y1(i) = 0;
end
end
figure(1)
subplot(3,1,1);
plot(m);
subplot(3,1,2);
plot(c);
subplot (3,1,3);
plot(y1);
```

OUTPUT:

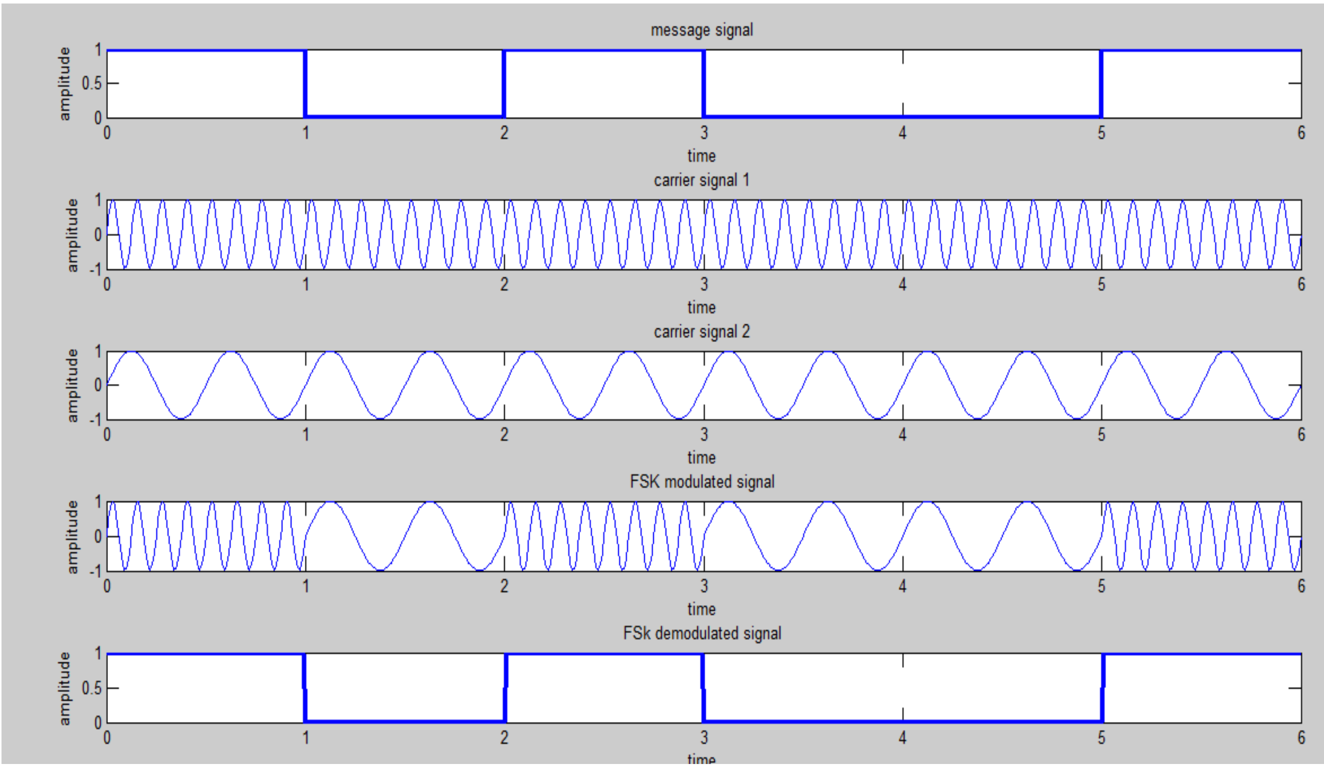


FSK PROGRAM:

```
clc;
clear all;
close all;
%carrier freq
f1=8;
f2=2;
a=1;
%6 bit are used
n=[1 0 1 1 0 0];
L=length(n);
if n(L)==1
   n(L+1)=1
else
   n(L+1)=0
end
tn=0:L;
%plot message
subplot(5,1,1);
stairs(tn,n ,'linewidth',3);
title('message signal');
xlabel('time');
ylabel('amplitude');
```

```
%plot carrier sig
t=0:0.01:6;
y1=a*sin(2*pi*f1*t);
y2=a*sin(2*pi*f2*t);
subplot(5,1,2);
plot(t,y1);
title('carrier signal 1');
xlabel('time');
ylabel('amplitude');
subplot(5,1,3);
plot(t,y2);
title('carrier signal 2');
xlabel('time');
ylabel('amplitude');
%modulation process
for  i=1:6
for j=(i-1)*100:i*100
if (n(i)==1)
        s(j+1)=y1(j+1);
else
        s(j+1)=y2(j+1);
end
end
end
%plot fsk signal
subplot(5,1,4);
plot(t,s);
title('FSK modulated signal');
xlabel('time');
ylabel('amplitude');
%demodulation process
for i=1:6
for j=(i-1)*100:i*100
if(s(j+1)==y1(j+1))
        s(j+1)=1;
else
        s(j+1)=0;
end
end
end
%plot demodul
subplot(5,1,5);
plot(t,s,'linewidth',3);
title('FSk demodulated signal');
xlabel('time');
ylabel('amplitude');
```

OUTPUT:

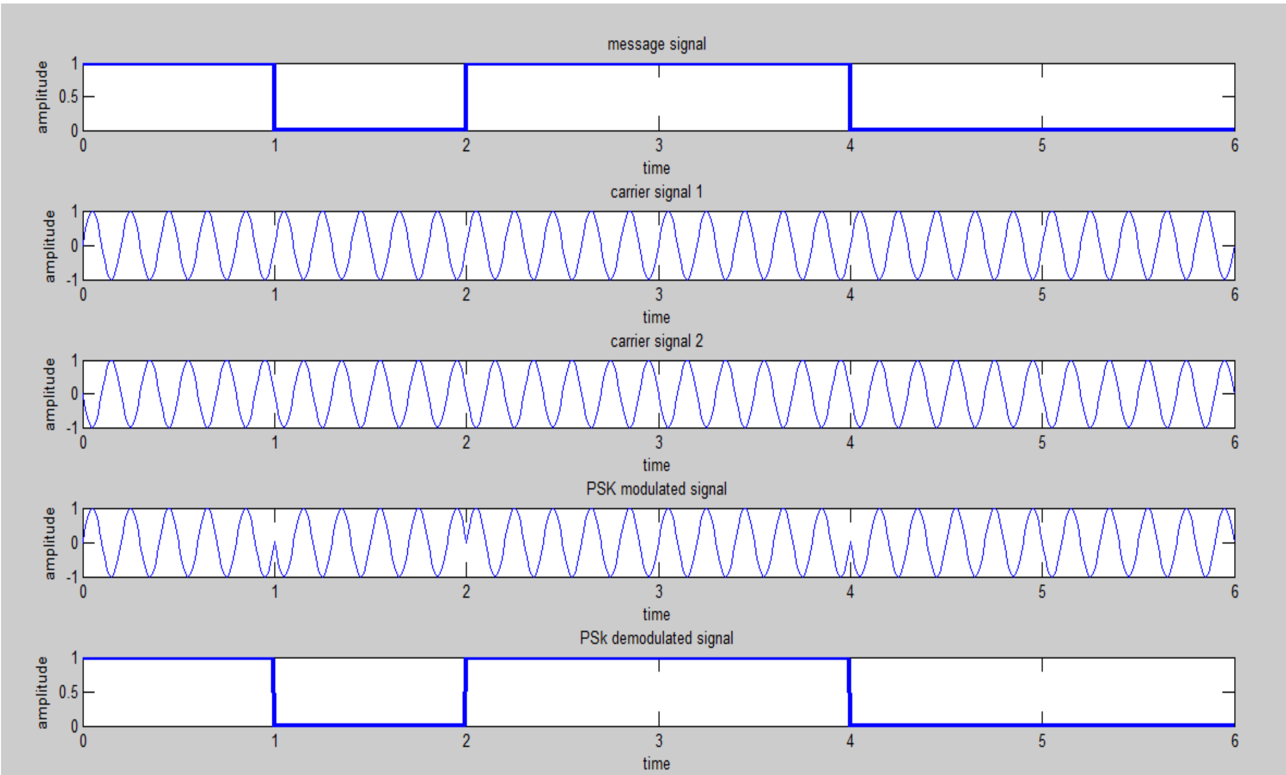


PROGRAM:

```
clc;
clear all;
close all;
%carrier freq
f=5;
a=1;
%6 bit are used
n=[1 0 1 1 0 0];
l=length(n);
if n(l)==1
    n(l+1)=1
else
    n(l+1)=0
end
L1=length(n);
t2=0:L1-1;
%plot message
subplot(5,1,1);
stairs(t2,n,'linewidth',3);
```

```
title('message signal');
xlabel('time');
ylabel('amplitude');
%plot carrier sig
t=0:0.01:6;
y1=a*sin(2*pi*f*t);
y2=-a*sin(2*pi*f*t);
subplot(5,1,2);
plot(t,y1);
title('carrier signal 1');
xlabel('time');
ylabel('amplitude');
subplot(5,1,3);
plot(t,y2);
title('carrier signal 2');
xlabel('time');
ylabel('amplitude');
%modulation process
for  i=1:6
for j=(i-1)*100:i*100
if (n(i)==1)
        s(j+1)=y1(j+1);
else
        s(j+1)=y2(j+1);
end
end
end
%plot psk signal
subplot(5,1,4);
plot(t,s);
title('PSK modulated signal');
xlabel('time');
ylabel('amplitude');
%demodulation process
for i=1:6
for j=(i-1)*100:i*100
if(s(j+1)==y1(j+1))
        x(j+1)=1;
else
        x(j+1)=0;
end
end
end
%plot demodulated sig
subplot(5,1,5);
plot(t,x,'linewidth',3);
title('PSk demodulated signal');
xlabel('time');
ylabel('amplitude');
```

OUTPUT:



RESULT:

Thus ASK ,FSK and PSK modulation was simulated using MATLAB

EXP. NO:11(a)	SIMULATION OF DPSK QPSK and QAM GENERATION AND DETECTION SCHEMES
DATE:	

AIM:

To perform DPSK QPSK and QAM generation using MATLAB program.

SOFTWARE REQUIRED:

- MATLAB

ALGORITHM:

STEP 1: Start the program.

STEP 2: GET the two signals

STEP 3 Perform DPSK QPSK and QAM

STEP 4: Plot the time along x-axis and amplitude along y-axis.

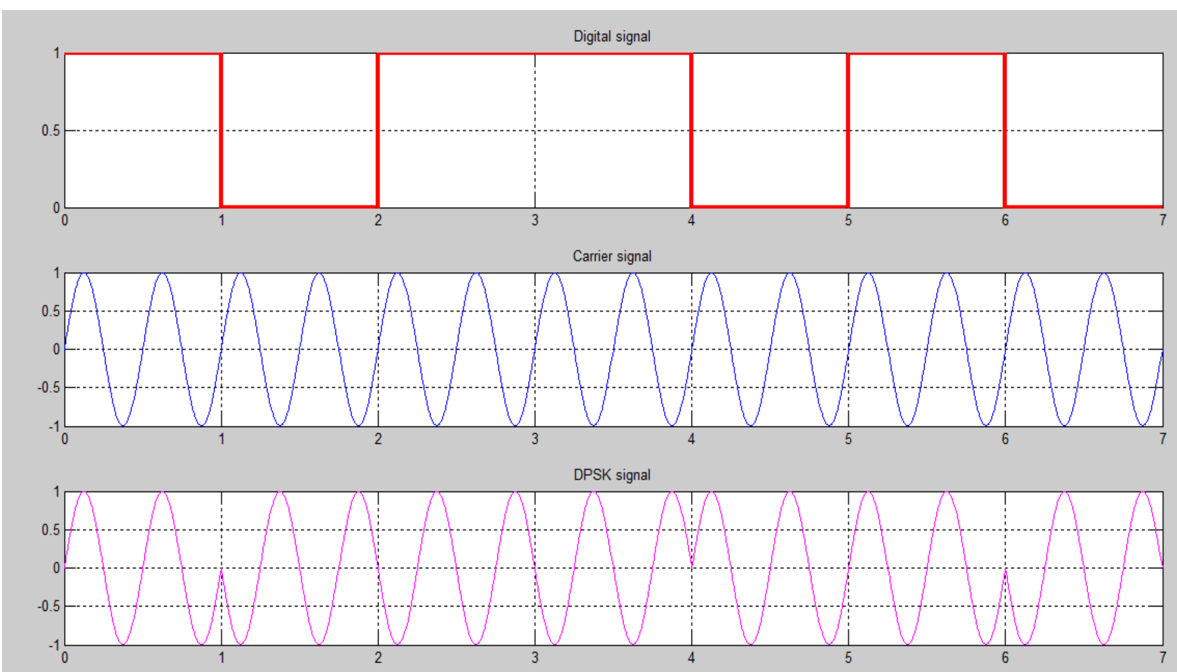
STEP 5: Stop the program.

DPSK PROGRAM:

```
clc;
clear all;
close all;
t=0:.01:1;
fc = 2;
M = [1 0 1 1 0 1 0]
codedM=1;
for i=1:1:length(M)
   bit = not(xor(codedM(i),M(i)));
   codedM = [codedM bit];
end
codedM = codedM(2:length(codedM));

messageLength=length(M);
time=[];
digitalSignal=[];
dpskSignal=[];
carrierSignal=[];
for i=1:1:messageLength
   carrier = sin(2*pi*fc*t);
   carrierSignal = [carrierSignal carrier];
   if M(i) == 1
      bit = ones(1,length(t));
   else
      bit = zeros(1,length(t));
   end
```

```
    digitalSignal = [digitalSignal bit];

    if codedM(i) == 1
        DPSK = sin(2*pi*fc*t+0);
    else
        DPSK = sin(2*pi*fc*t+pi);
    end

    dpskSignal = [dpskSignal DPSK];
    time=[time t];
    t=t+1;
end

subplot(3,1,1);
plot(time,digitalSignal,'r','linewidth',3);
grid on;
title('Digital signal');

subplot(3,1,2);
plot(time,carrierSignal);
grid on;
title('Carrier signal');

subplot(3,1,3);
plot(time,dpskSignal,'m');
grid on;
title('DPSK signal');
```

OUTPUT:

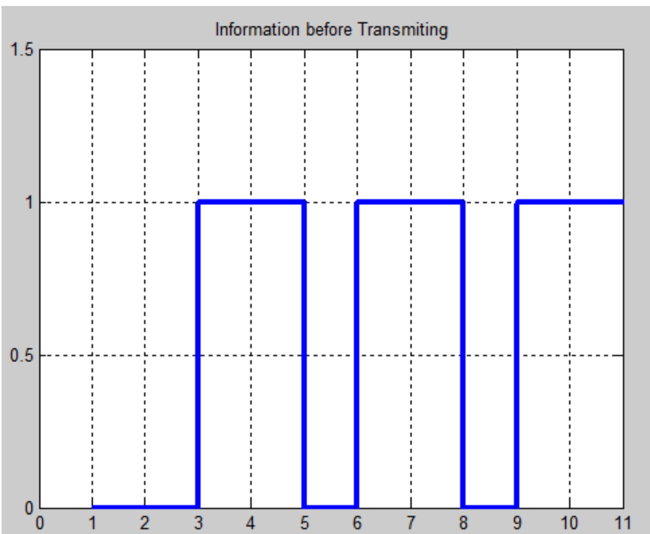


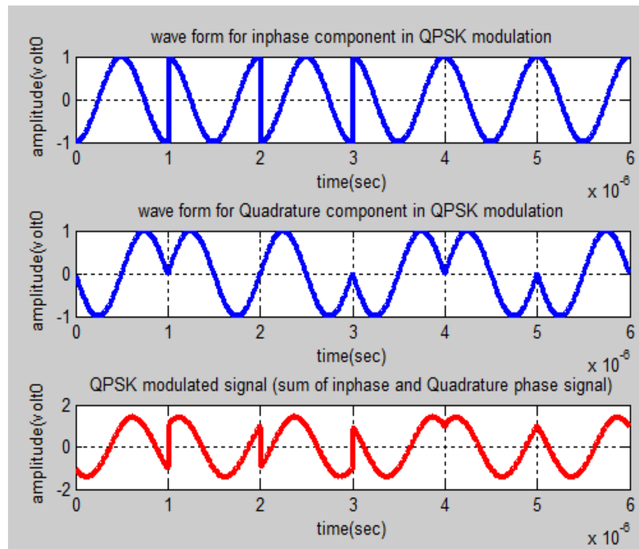
QPSK PROGRAM:

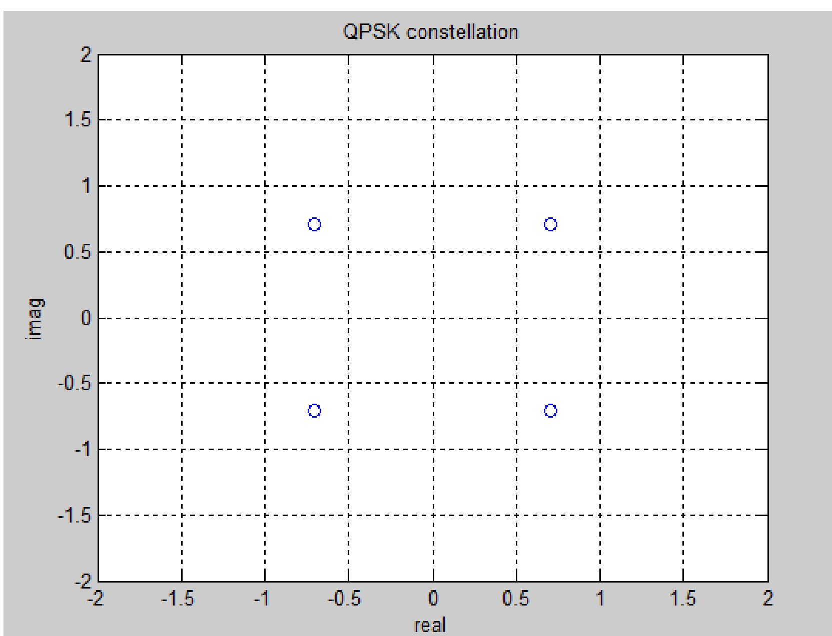
```
clc;
clear all;
close all;
data=[0 0 1 1 0 1 1 0 1 1 1 0]; % information
figure(1)
stairs(data, 'linewidth',3), grid on;
title(' Information before Transmiting ');
axis([ 0 11 0 1.5]);
data_NZR=2*data-1; % Data Represented at NZR form for QPSK modulation
s_p_data=reshape(data_NZR,2,length(data)/2); % S/P convertion of data
br=10.^6; %Let us transmission bit rate  1000000
f=br; % minimum carrier frequency
T=1/br; % bit duration
t=T/99:T/99:T; % Time vector for one bit information
y=[];
y_in=[];
y_qd=[];
d=zeros(1,length(data)/2);
for i=1:length(data)/2
    p=data(2*i);
    imp=data(2*i - 1);
    y1=s_p_data(1,i)*cos(2*pi*f*t); % inphase component
    y2=s_p_data(2,i)*sin(2*pi*f*t) ;% Quadrature component
    y_in=[y_in y1]; % inphase signal vector
    y_qd=[y_qd y2]; %quadrature signal vector
    y=[y y1+y2]; % modulated signal vector
    if (imp == 0) && (p == 0)
       d(i)=exp(j*pi/4);%45 degrees
    end
    if (imp == 1)&&(p == 0)
        d(i)=exp(j*3*pi/4);%135 degrees
    end
    if (imp == 1)&&(p == 1)
        d(i)=exp(j*5*pi/4);%225 degrees
    end
    if (imp == 0)&&(p == 1)
        d(i)=exp(j*7*pi/4);%315 degrees
    end
end
Tx_sig=y; % transmitting signal after modulation
qpsk=d;
tt=T/99:T/99:(T*length(data))/2;
figure(2)
subplot(3,1,1);
plot(tt,y_in,'linewidth',3), grid on;
title(' wave form for inphase component in QPSK modulation ');
xlabel('time(sec)');
ylabel(' amplitude(volt0');
subplot(3,1,2);
plot(tt,y_qd,'linewidth',3), grid on;
title(' wave form for Quadrature component in QPSK modulation ');
```

```
xlabel('time(sec)');
ylabel(' amplitude(volt0');
subplot(3,1,3);
plot(tt,Tx_sig,'r','linewidth',3), grid on;
title('QPSK modulated signal (sum of inphase and Quadrature phase signal)');
xlabel('time(sec)');
ylabel(' amplitude(volt0');
figure(3);
plot(d,'o');%plot constellation without noise
axis([-2 2 -2 2]);
grid on;
xlabel('real'); ylabel('imag');
title('QPSK constellation');
```

OUTPUT:







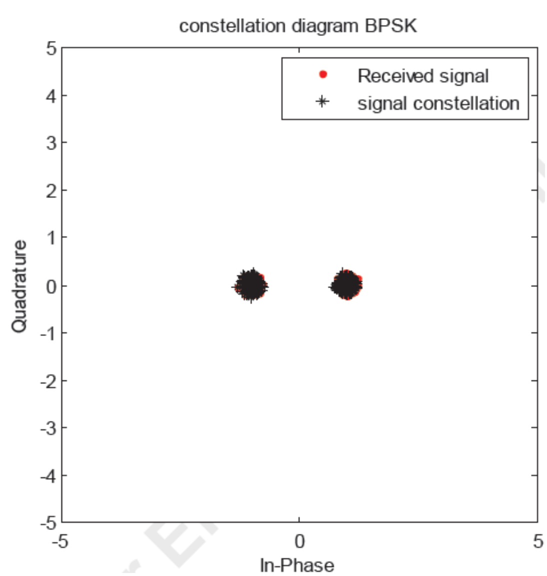
QAM

THEORY:
A constellation diagram is a representation of a signal modulated by an arbitrary digital modulation scheme. It displays the signal as a two dimensional scatter diagram in the complex plane at symbol sampling instants. It can also be viewed as the possible symbols that may be selected by a given modulation scheme as points in the complex plane.

PROGRAM: BPSK

```
clc;
clear all;
close all;
M=2;
k=log2(M);
n=3*1e5;
nsamp=8;
X=randint(n,1);
xsym = bi2de(reshape(X,k,length(X)/k).','left-msb');
Y_psk= modulate(modem.pskmod(M),xsym);
Ytx_psk = Y_psk;
EbNo=30;
SNR=EbNo+10*log10(k)-10*log10(nsamp);
Ynoisy_psk = awgn(Ytx_psk,SNR,'measured');
Yrx_psk = Ynoisy_psk;
h1=scatterplot(Yrx_psk(1:nsamp*5e3),nsamp,0,'r.');
hold on;
scatterplot(Yrx_psk(1:5e3),1,0,'k*',h1);
title('constellation diagram BPSK');
legend('Received signal' ,'signal constellation');
axis([-5 5 -5 5]);
hold off;
```

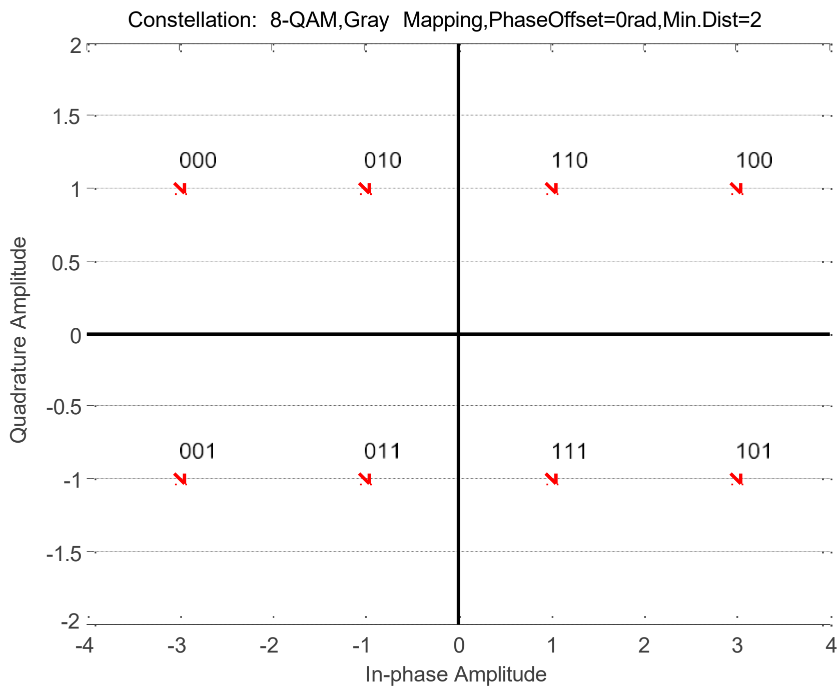
OUTPUT:



SIGNAL CONSTELLATION FOR 8-QAM

```
data=randi([0 1],96,1);
hModulator=comm.RectangularQAMModulator(8,'BitInput',true);
hModulator.PhaseOffset=0;
modData=step(hModulator,data);
constellation(hModulator)
```

SIMULATED OUTPUT:



RESULT:

Thus the operation of DPSK , QPSK, and constellation diagrams of digital modulation system QAM is simulated & plotted in MATLAB.

EXP. NO:15	SIMULATION OF LINEAR BLOCK AND CYCLIC ERROR CONTROL CODING SCHEMES
DATE:	

AIM:

To perform error control coding (linear block code)using MATLAB program.

ALGORITHM

STEP 1: Start the program.
STEP 2: GET the two signals
STEP 3: perform the operation by generate matrix finding hamming code
STEP 4: display the o/p sequence
STEP 5: display the possible codeSTEP 6: Stop the program.

PROGRAM:

CYCLIC BLOCK CODE

```
clc;
clear
all;

%%%%code can take values (7,4),(7,3),(8,3),(8,4),....
codeLength=input('Enter the length of the code :');            %Length of the output code
wordmessageLength=input('Enter the length of the message:'); %Length of the input
message bitsif (messageLength<codeLength)
   Message = input('Enter the message
   bits:');disp(Message);

   disp ('Cyclic polynomial');
   cyclicPolynomial=cyclpoly(codeLength,messageLength,'min'); %Creates a polynomials for cyclic
   codesdisp(cyclicPolynomial);

   disp('Encoded word');
   %Encodes the message bits using cyclic code
   code=encode(Message,codeLength,messageLength,'cyclic/fmt',cyclicPolynomial);
   disp(code);

   disp('Error pattern generation');
   error=randerr(1,codeLength);              %Introduces a random one bit
   errordisp(error);

   disp('Received vector');
   receivedCode = xor(code,error);  %Xor the error with the code word
   disp(receivedCode);
```

```
    disp('Decode message bits');
   %Decodes the received code word and recovers the original message
    msg=decode(receivedCode,codeLength,messageLength,'cyclic');
    disp(msg);
else
    disp('k value should be less than n');
end
```

SAMPLE OUTPUT

```
Enter the length of the code :7
Enter the length of the message:4
Enter the message bits:[1 0 1 0]
     1     0     1     0
 Cyclic polynomial
     1     0     1     1
Encoded word
     0     1     1     1     0     1     0
Error pattern generation
     0     0     0     0     1     0     0
Received vector
     0     1     1     1     1     1     0
Decode message bits
     1     0     1     0
```

LINEAR BLOCK CODE

```
clc;
clear all;
n=input('Enter the code size(n):');          %Length of the output code word
k=input('Enter the message size(k):');    %Length of the input message bits

if(k<n)
    m=input('Enter the message:');
    p=[1 1 0;0 1 1;1 1 1;1 0 1]; %Parity matrix
    g=[eye(k),p];                             %Generator matrix
    disp('Generator matrix:');
    disp (g);

    % encode
```

```
    c=rem(m*g,2);  %Create the code by multiplying the message and generator polynomial
    disp('coded message at transmission side:');
    disp (c);

    % noise
    e=randerr(1,n);
    r=xor(c,e);           %Introduce a random one bit error in the message
    disp('Received code at received side:');
    disp(r);
     %Parity matrix
    h=[eye(n-k),[p]'];       %Creates a parity check matrix
    disp('Parity matrix:');
    disp(h);
    %Syndrome
    disp('Syndrome');
    ht=h';                     % Transpose of the parity check matrix
    s=mod(r*ht,2);     % Calculates the syndrome value from the received code and parity matrix
    disp(s);
    %Find the error bit from the transpose of the parity check matrix
    for j=1:n
        t=n-k;
        for i=1:n-k
            if(s(1,i)==ht(j,i))
            t=t-1;
            end
        end
        if(t==0)
        break;
        end
    end

    disp('Position of errorbit is');
    disp(j);

    %Error pattern
    r(j)=-r(j); %Correct the error
    disp('Corrected code:');
    disp(r);

    for i=1:k
      dm(i)=r(i); %The first k bits of the corrected code word is the message
    end
    disp('Decoded message:');
    disp(dm);

else
    disp('k should be less than n');
end
```

SAMPLE OUTPUT

Enter the code size(n):7

Enter the message size(k):4

Enter the message:[1 0 1 1]

Generator matrix:

```
1 0 0 0 1 1 0
0 1 0 0 0 1 1
0 0 1 0 1 1 1
0 0 0 1 1 0 1
```

coded message at transmission side:

```
1 0 1 1 1 0 0
```

Random one bit error

```
0 1 0 0 0 0 0
```

Received code at received side:

```
1 1 1 1 1 0 0
```

Parity matrix:

```
1 0 0 1 0 1 1
0 1 0 1 1 1 0
0 0 1 0 1 1 1
```

Syndrome

```
0 1 0
```

Position of errorbit is

```
2
```

Corrected code:

```
1 0 1 1 1 0 0
```

Decoded message:

```
1 0 1 1
```

RESULT:

Thus encoding and decoding of block codes are performed using MATLAB.