Experiment No: 04

Experiment name:

To study and analyze the pulse Amplitude Modulation (PAM)

Objectives:

(i) To understand the message or modulating signal and carriere pulse train.

(ii) To understand the wave form of the pulse amplitude modulation.

(iii) To understand the working principle of pulse amplitude modulation.

(iv) To under-stand the mathematical expression of pulse amplitude modulation.

Theory:

The process of changing some characteristic of a carriere wave in accordance with the intensity of the signal is known as modulation. Pulse amplitude modulation is an analog modulating scheme in which the amplitude of the pulse carriere varies proportional to the instantaneous amplitude of the message signal. Pulse modulation is a type of modulation in which the signal is transmitted in the form of pulse. It can be used to transmit analoge and digital information. pulse modulation can be classified into two major types:

1) Analoge pulse modulation.
2) Digital Pulse modulation.

The analoge modulation technique are mainly classified into three part:

I) Pulse amplitude Modulation (PAM)

II) Pulse width modulation (PWM)

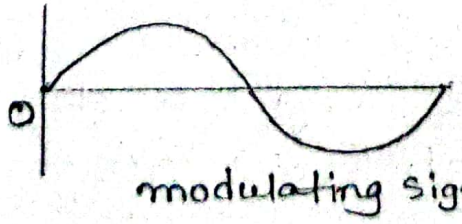
III) Pulse position modulation (PPM)

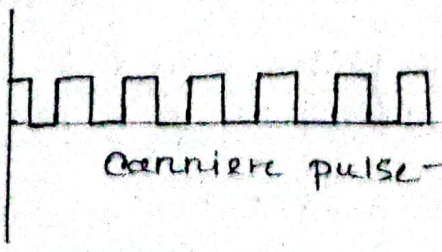
Pulse Amplitude Modulation (PAM):

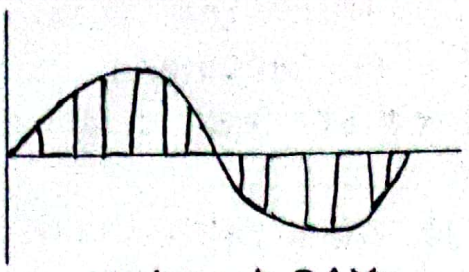
PAM stands for pulse amplitude modulation. It is a modulation technique in which the amplitude of the pulsed carrier signal is changed according to the amplitude of the message signal.

The pulse amplitude modulated signal will follow the amplitude of the original signal, as the signal traces out the path of the whole wave. In natural PAM a signal sampled at the Nyquist rate is reconstructed by passing it through an efficient Low pass Frequency (LPF) with exact cutoff frequency.

The following figure explain the pulse amplitude modulation.

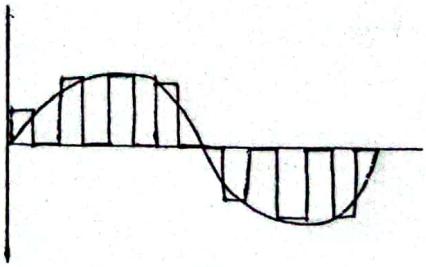






Natural PAM

Through the PAM signal is passed through an LPF, it cannot recover the signal without distortion. Hence to avoid this noise, flat-top sampling is done as shown in the following figure:



Flat-top PAM.

Mathematical Expression:

Let the message signal is:

$$V_m = V_m \sin \omega_m t$$

If $x(t)$ is a periodic signal with period T_0 then it should satisfy the definition stated as $x(t) = x(t + T_0)$. Then pulse train is a periodic signal with some fundamental period say T_0. Then the information present in each period of the pulse train is given by:

$$P = V_p \quad 0 \le t \le \Delta$$
$$= 0 \quad \Delta \le t \le T_0$$

where Δ is the width of the pulse and the leading edge of the pulse is assumed to be coinciding with the starting of the interval in each period.

The pulse amplitude modulated wave is the time domain is obtained by multiplying the message with the pulse train and is given by;

$$P_a = P \times x_m .$$

Substituting P in the above equation we get.

$$P_a = V_p V_m \sin \omega_m t \quad 0 \leq t \leq \Delta$$

$$= 0 \quad 0 \leq t \leq T_o$$

Experiment No: 05

Experiment name:
To study and analyze the Pulse position modulation (PPM)

Objectives:
(I) To underestand the message or modulating signal and carrier pulse train.
(II) To underestand the wave-form of the pulse amplitude modulation.
(III) To understand the working principle of Pulse ~~amplitude~~ position modulation.
(IV) To underestand the mathematical expression of pulse amplitude modulation.

Theory:
The process of changing some characteristic of a carrier wave in accordance with the intensity of the signal is known as modulation. Pulse position modulation is an analog modulating scheme in which the position of the pulses in changed in accordance of the modulating signal.

Pulse modulation is a type of modulation in which the signal is transmitted in the form of pulse. It can be used to transmit analoge and digital information. pulse can be classified into two major types:

1) Analoge pulse modulation.
2) Digital pulse modulation.

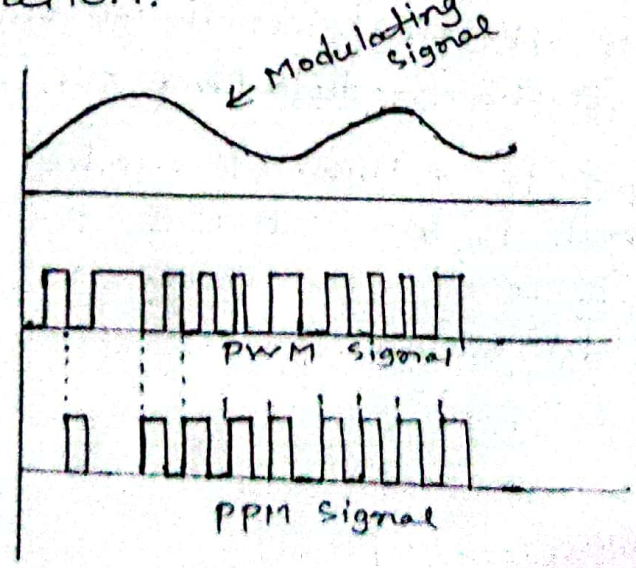
The analoge modulation techniques are mainly classified into three part.

1) Pulse amplitude modulation.
2) Pulse position modulation.
3) Pulse position modulation.

Pulse position modulation (PPM)

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

The transmitter has to send synchronizing pulses (or simple sync pulses) to keep the transmitter and receiver in synchronism. these sync pulses help maintain the position of the pulses. The following figures explain the pulse position modulation.



Here the pulse amplitude and pulse width are the two constant that does not show variation with the amplitude of the modulating signal but only the position shows variation.

Mathematical Expression:

Pulse position modulation (PPM) is defined as the process of varying of position of the pulse with respect to the instantaneous variations of the message signal.

Let t_p indicates the timing instant of the leading or trailing edge of the pulse in each period of the pulse train. In PPM:

$$t_p \propto V_m$$

Mathematically, the position of the leading or trailing edge of the pulse (in each period) in PPM signal is given by:

$$t_p = f(V_m)$$

When there is no message, then the position of the leading or trailing edge of the pulse will be equal to the original position and hence $t_p = 0$. For positive values of message, the position will be proportionately shifted right by $t_p = f(V_m)$. For negative values of message, the position will be proportionally shifted left by $-t_p = -f(V_m)$ factor.

Experiment No: 06

Experiment name:

To study and analyze the Pulse width modulation. (PWM)

Objectives:

(i) To understand the message and modulating signal.
(ii) To understand the waveform of the pulse width modulation.
(iii) To understand the working principle of Pulse width modulation.
(iv) To understand the mathematical expression of Pulse width modulation

Theory:

The process of changing some characteristic of a carrier wave in accordance with the instensity of the signal is known as modulation Pulse modulation is a type of modulation in which the signal is transmitted in the form of pulse. It can be used to transmit analoge and digital information. Pulse modulation can be classified into two major types.

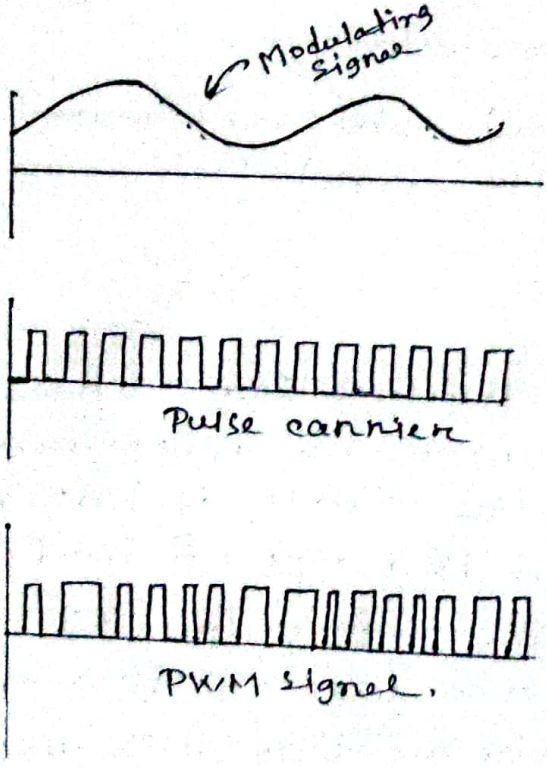
1) Analoge pulse modulation.
2) Digital Pulse modulation.

The analoge modulation technique are mainly classified into three parts

1) Pulse amplitude modulation.
2) Pulse position modulation.
3) Pulse width modulation.

Pulse width modulation (PWM)

PWM is an aeronym used fore pulse width modulation. In PWM the width of the pulses is varied according to the amplitude of the message signal. The figure below shows the pulse width modulation signal:



As we can see that unlike PAM, in this technique of the signal is constant and only the width is varying. PWM technique is similare to frequency modulation because, by the variation in the width of the pulses, the frequeny of the pulses in the PWM signal shows variation.

Mathematical Expression:

Let A be the width of the pulse in the unmodulated pulse train. In PWM

$$A \propto V_m$$

Mathematically, the width of pulse in PWM signal is given by:

$$A_m = A(1+V_m)$$

when there is no message that is $V_m = 0$ then the width of the pulse will be equal to the original width A. For positive values of message, the width will be proportionately increased by $(1+V_m)$ factor. For negative value of the message, the width decreased by $(1-V_m)$ factor.

Experiment No: 07

Experiment name:

To study and analyze the ~~pulse~~ Amplitude shift keying (ASK)

Objectives:

I) To understand about digital modulating signal technique.

II) To understand about the binary signal, carriere signal and modulated signal.

III) To understand about the working principle of amplitude shift keying modulation.

IV) To understand the mathematical expression of amplitude shift keying modulation.

Theory:

Modulation is the process of converting data into radio waves by adding information to an electronic or optical carriere signal. There are two kind of modulating technique I) Analoge modulating technique. II) Digital modulating technique.

Digital modulating technique is the process by which some characteristic (frequency, phase, amplitude or combinations thereof) of a carriere frequency is varied in accordance with a digital signal

e.g

There are different modul digital modulating sign technique:

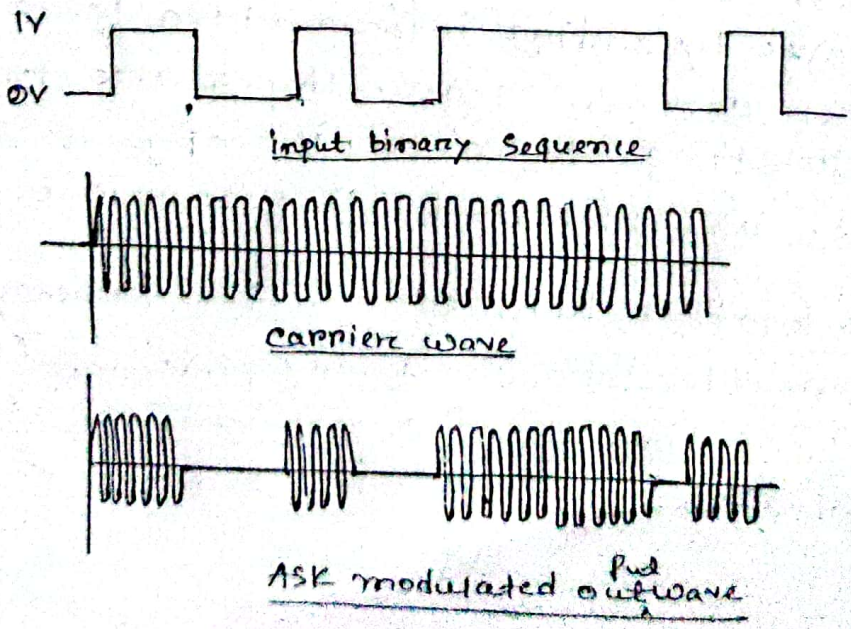
1) Amplitude shift keying.
2) frequency shift keying.
3) phase shift keying.

Amplitude shift keying (ASK)

Amplitude shift keying (ASK) is a type of amplitude modulation which represent the binary data in the form of variations in the amplitude of a signal.

Any modulated signal has a high frequency carrier. The binary signal when ASK modulated gives a zero value for Low input while it gives the carrier output for high input.

The following figure represents ASK Modulated waveform along with its input.



In amplitude shift keying the phase and frequency of the carrier wave are maintained at a constant level and only its amplitude is varied in accordance with the digitalized modulating signal. It is associated with two levels only. However there can be multiple levels of signal elements as well.

Mathematical Expression:

Let the message be binary sequence of 1s and 0's. It can be represented as a function of time as follows.

$V_m = V_m$ when symbol is 1.

$= 0$ when symbol is 0.

Let the carrier be defined as:

$$V_c = V_c \cos \omega_c t$$

The corresponding ASK signal is given by the product of V_m and V_c as:

$V_{ASK} = V_m V_c \cos \omega_c t$ when symbol is 1.

$= 0$ when symbol is 0.

Experiment No: 08

Experiment Name:

To study and analyze the frequency shift keying (FSK) modulation.

Objectives:

1) To understand about digital modulating technique.

2) To understand about the binary signal, carrier signal and modulated signal.

3) To understand about the working principle of frequency shift keying modulation.

4) To understand the mathematical expression of frequency shift keying modulation.

Theory:

Modulation is the process of converting data into radio waves by adding information to an electronic or optical carrier signal. There are two kind of modulating technique. 1) Analoge modulating technique and 1) Digital modulating technique.

Digital modulating technique is the process by which some characteristic (frequency, Phase, amplitude or combinations there of) of a carrier frequency is varied in accordance with a digital signal.

There are different digital modulating techniques.

1) Amplitude shift keying.
2) Frequency shift keying.
3) phase shift keying.

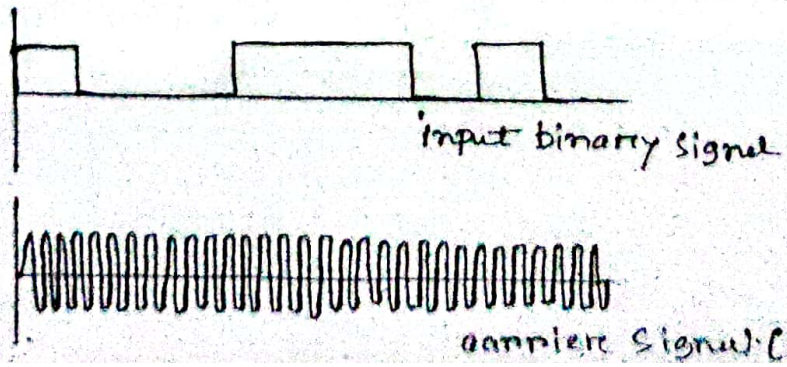
frequency shift keying:

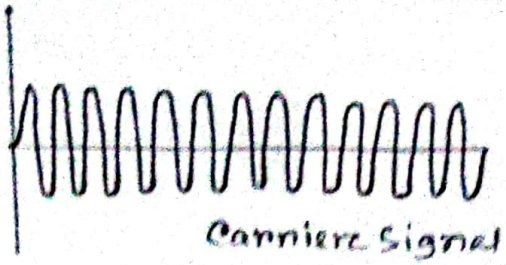
A digital modulation technique that allows data transmission by changing the frequency of the carriere wave according to the digital modulating signal is known as frequency shift keying. (FSK).

The simplest form of FSK is binary frequency shift keying. Here the frequency of the carriere wave changed between discrete binary values of the modulating signal. Thus, the frequeny of the carriere shows variation according to the binary message signal.

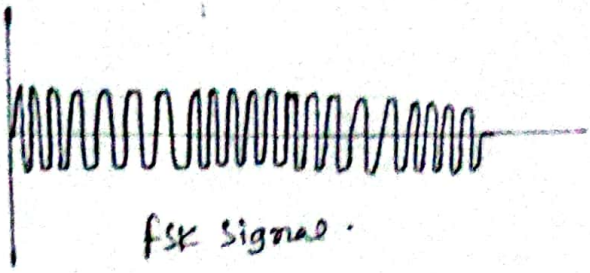
In frequency shift keying, the carriere is modulated in such a way that high-frequeny signal is achieved for high level that is 1 of binary data input. Similarly the low-frequency signal is obtained in case of low level that is 0 of the message signal.

The Figure below shows the frequeny shift keying technique.





Carriere Signal (2nd)



fsk signal.

Mathematical Signal Exp:

Let the two carrieres be defined as:

$V_{c1} = V_c \cos \omega_{c1} t$

$V_{c2} = V_c \cos \omega_{c2} t$

The corrresponding FSK signal is defined as:

$V_{ASK} = V_m V_c \cos \omega_{c1} t$ when symbol is 1

$= V_m V_c \cos \omega_{c2} t$ when symbol is 0

Experiment No: 09

Experiment Name:

To study and analyze the ~~fre~~phase shift keying (PSK)

Objectives:

1) To understand about digital modulating technique.
2) To understand about binary signal, carriere signal and modulated signal.
3) To understand about the working principle of phase shift keying modulation.
4) To understand about mathematical expression of phase shift keying modulation.

Theory:

Modulation is the process of converting data into radio waves by adding information to an electronic or optical carriere signal. There are two kind of modulating technique i) Analoge modulating technique and ii) Digital modulating technique.

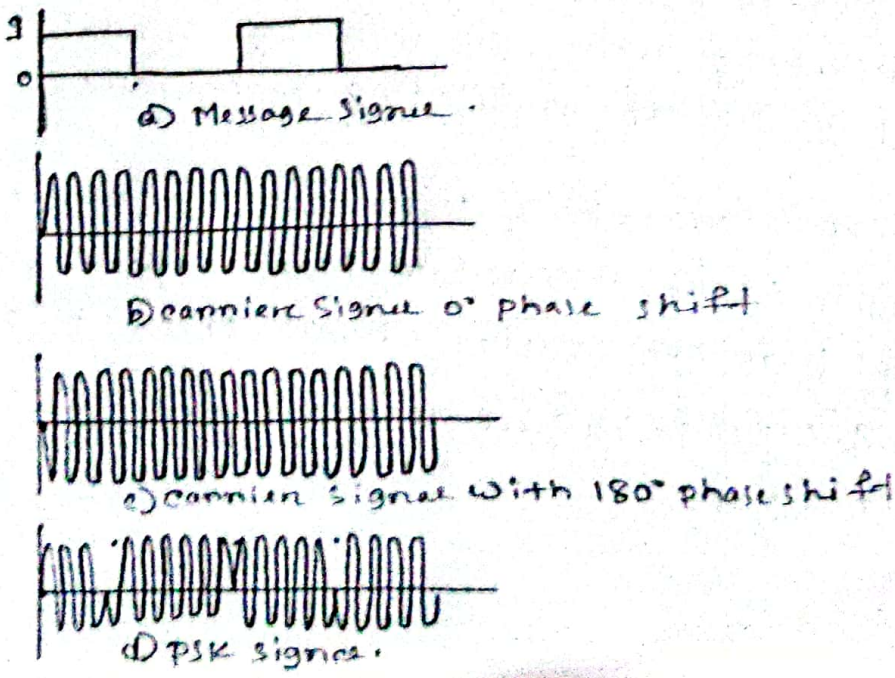
Digital modulating technique is the process by which some characteristics (frequency, phase, amplitude or combinations there of) of a carrier frequency is varied accordance with a digital signal.

There are different digital modulating techniques

i) Amplitude shift keying.
ii) frequency shift keying.
iii) phase shift keying.

Phase shift keying (PSK) modulation:

phase shift keying is a type of digital modulation technique where we transmit the data by modulating the phase of the carrier signal. The modulation is carried out by changing the inputs at regular intervals of time. Here we use finite phases and each of these phases can be represented by a unique pattern of bits. The number of bits used is the same in each case. A demodulator is used to determine the phase of the signal and recover the original data from it. Such a system is referred to as a coherent system. The phase shift keying modulation is shown in below figure:



a) Message signal.

b) carrier signal 0° phase shift

c) carrier signal with 180° phase shift

d) PSK signal.

More complex form of PSK employ four or eight phase. This allows more bits to be transmitted for each phase angle used.

Mathematical Expression:

Let two carriers signal defined as:

$$V_{c1} = V_c \cos \omega_c t$$
$$V_{c2} = -V_c \cos \omega_c t$$

The corresponding PSK signal is defined as:

$$V_{PSK} = V_m V_c \cos \omega_c t \quad ; \text{ when symbol is 1}$$
$$= -V_m V_c \cos \omega_c t \quad ; \text{ when symbol is 0}$$