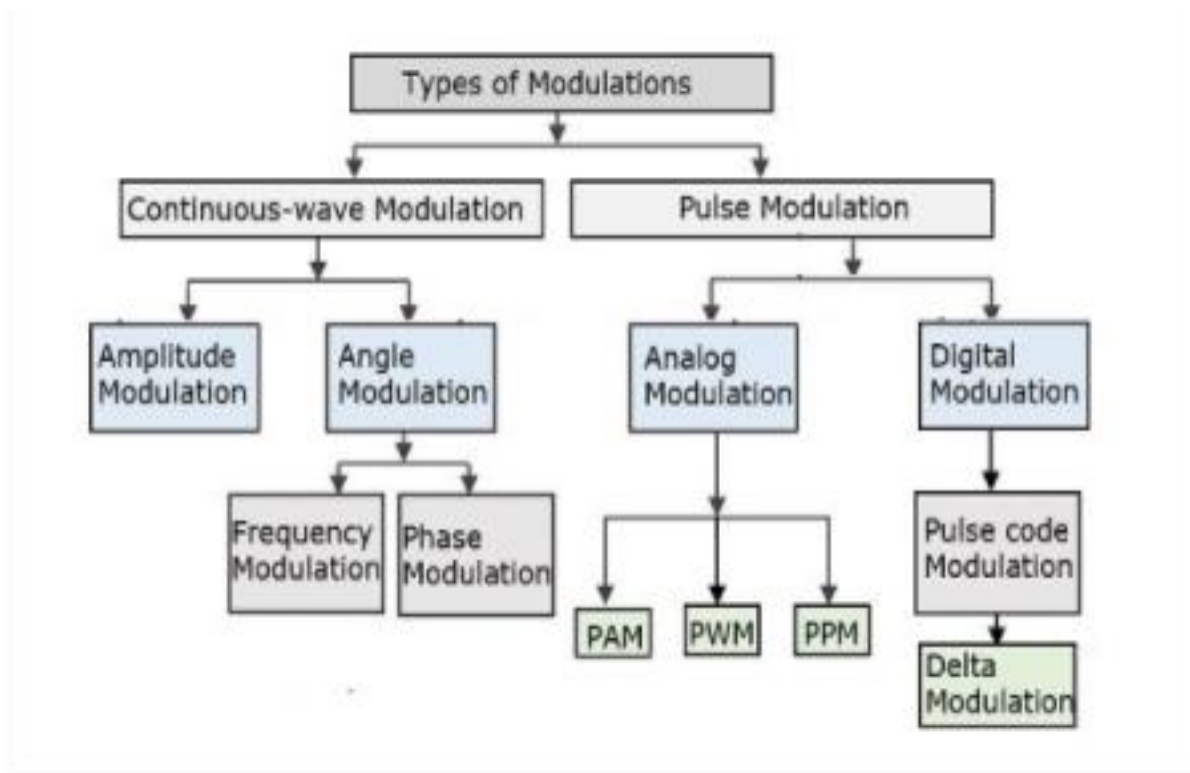# PULSE MODULATION

Pulse modulation is a type of modulation in which the signal is transmitted in the form of pulses. In pulse modulation, continuous signals are sampled at regular intervals.

Pulse Modulation is further divided into Analog and Digital modulation and further analog and digital modulation is subdivided in PAM,PWM,PPM (analog) and PCM,DM(digital).

A block diagram showing the basic classification is shown below.

In this lab session we will study only the analog part i.e,

- Pulse Amplitude Modulation (PAM)
- Pulse Width Modulation (PMW)
- Pulse Position Modulation (PPM)

Pulse Amplitude Modulation(PAM):

In Pulse-Amplitude Modulation (PAM) a pulse signal is used to sample an analog signal. The result is a train of constant-width pulses. **The amplitude of each pulse is proportional to the amplitude of the message signal at the time of sampling.**
The PAM signal follows the amplitude of the original signal, as the signal traces out the path of the whole wave.
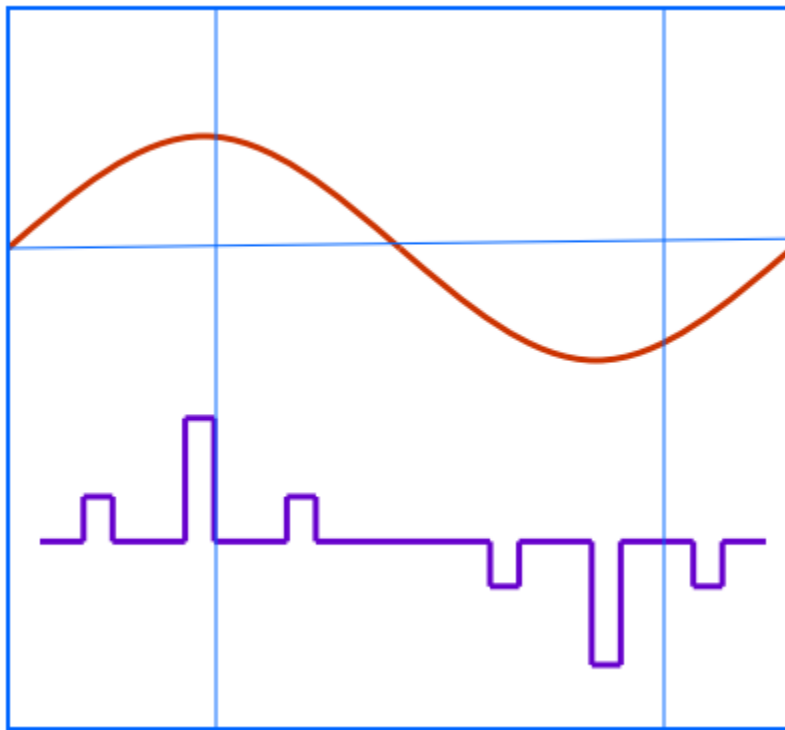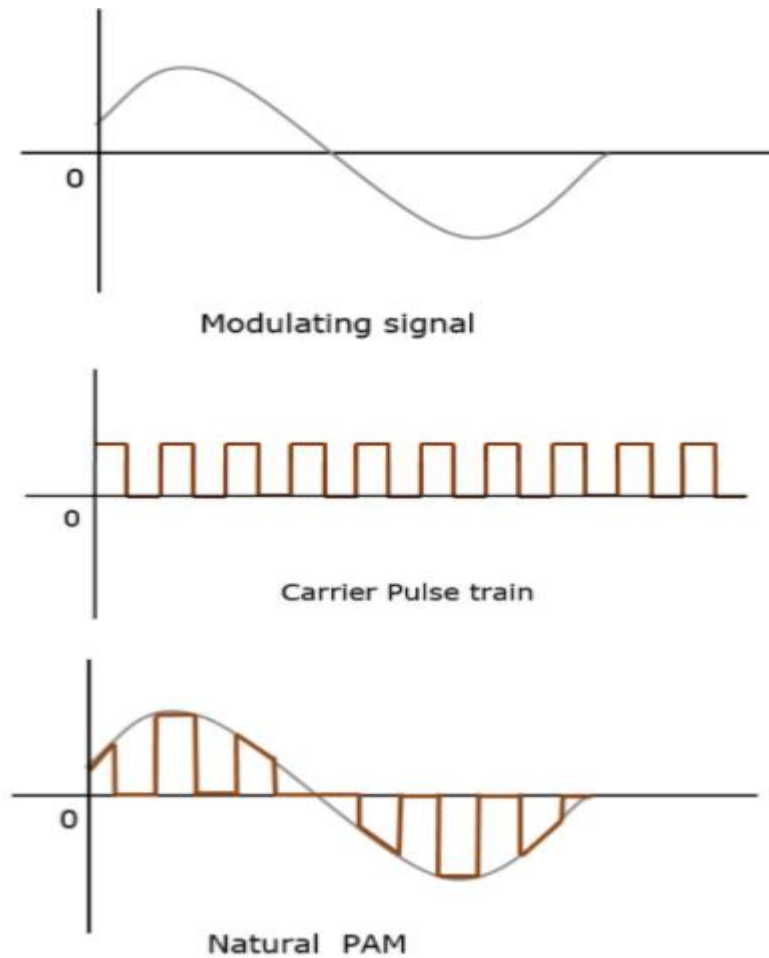

PAM Signal Generation

We can generate PAM signal by two types of sampling possible.

a) Natural Sampling
b) Flat-top Sampling

Natural Sampling:
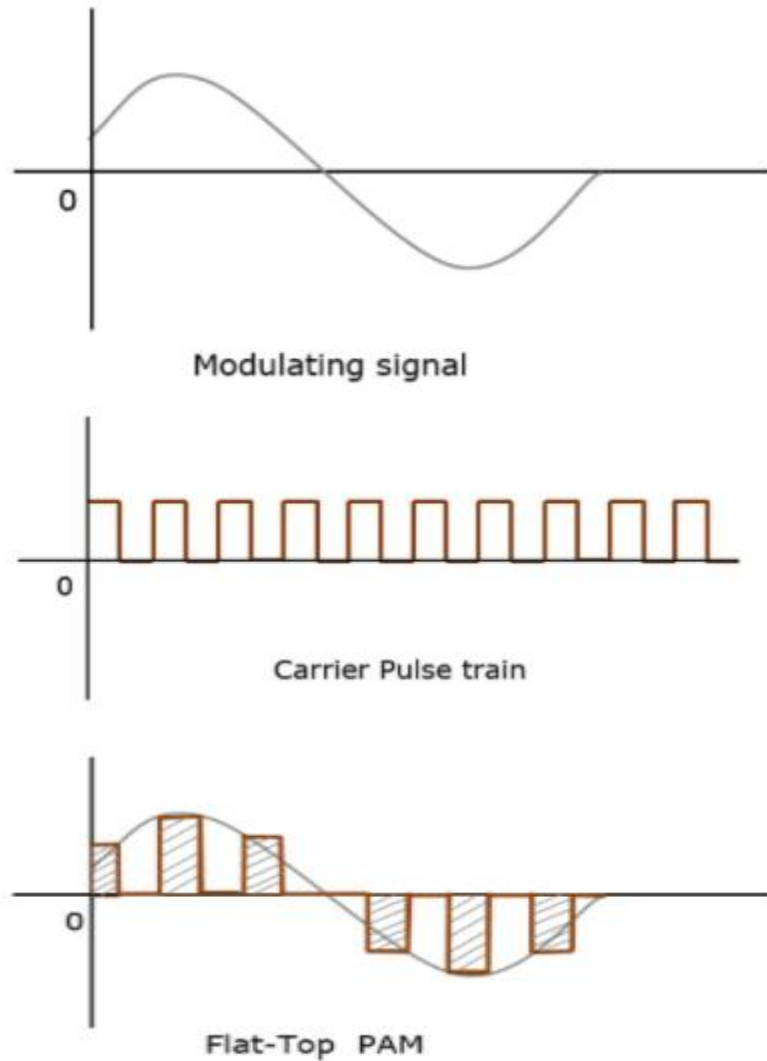

Modulating signal

Carrier Pulse train

Natural PAM

For a PAM signal produced with natural sampling, the sampled signal follows the waveform of the input signal during the time that each sample is taken.
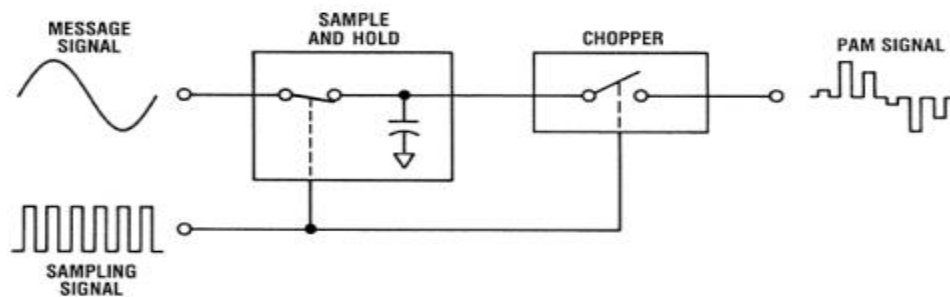
Generation of PAM signal by Natural Sampling-

Flat-Top Sampling:

Modulating signal

Carrier Pulse train

Flat-Top PAM
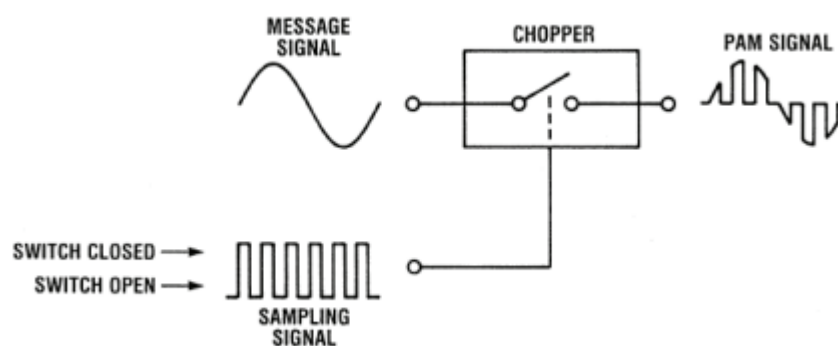
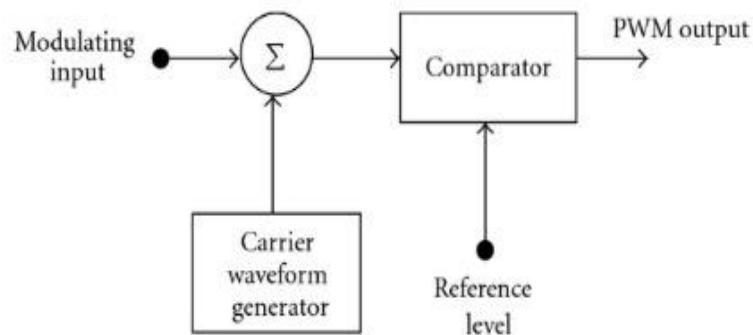*Generation of PAM signal by Flat-top Sampling-*

a sample-and-hold circuit is used to hold the amplitude of each pulse at a constant level.
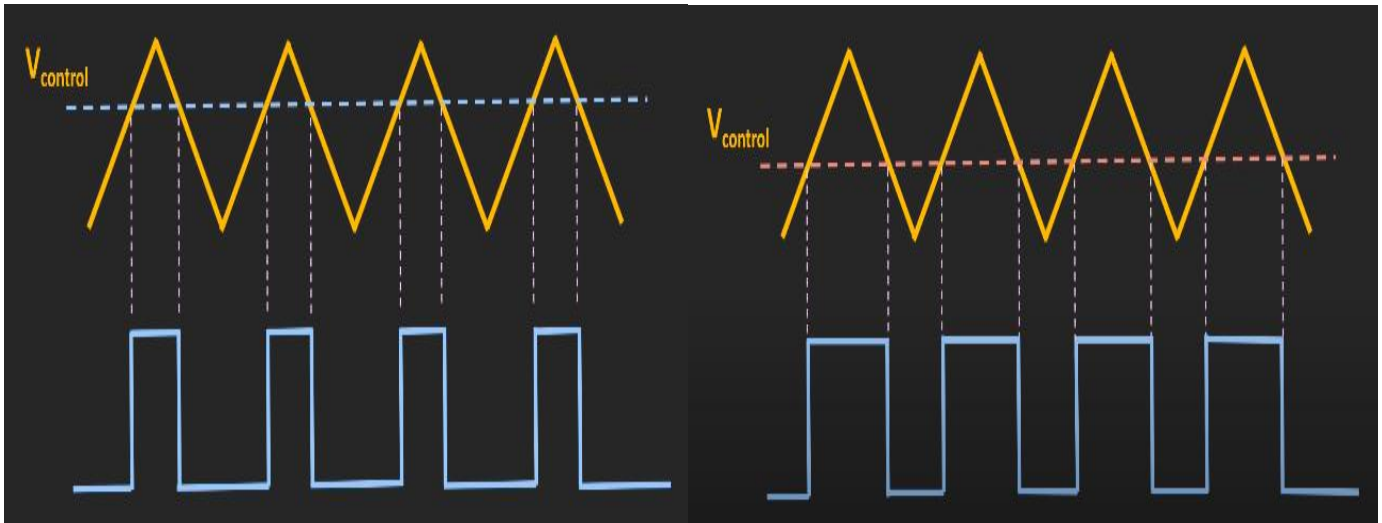
Pulse Width Modulation(PWM):

In this type, the amplitude is maintained constant but the duration or length or width of each pulse is varied in accordance with instantaneous value of the analog signal.
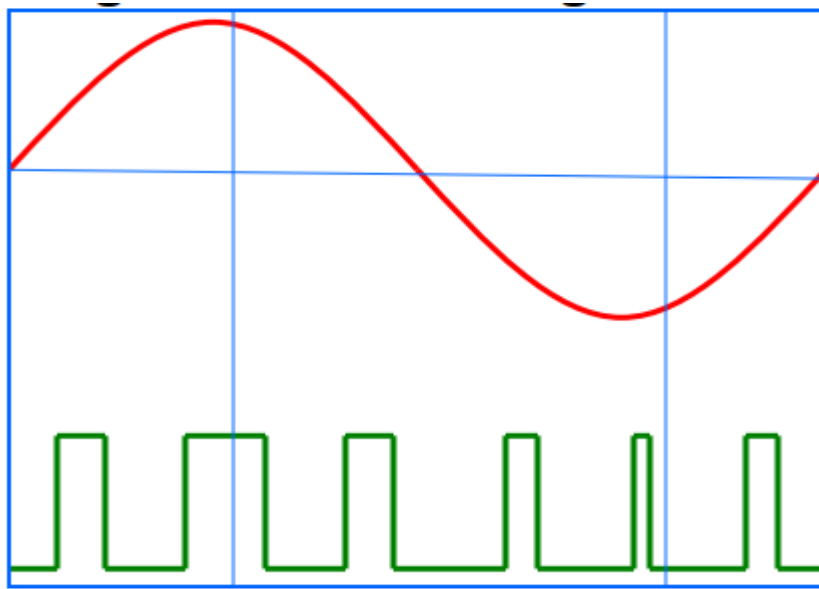
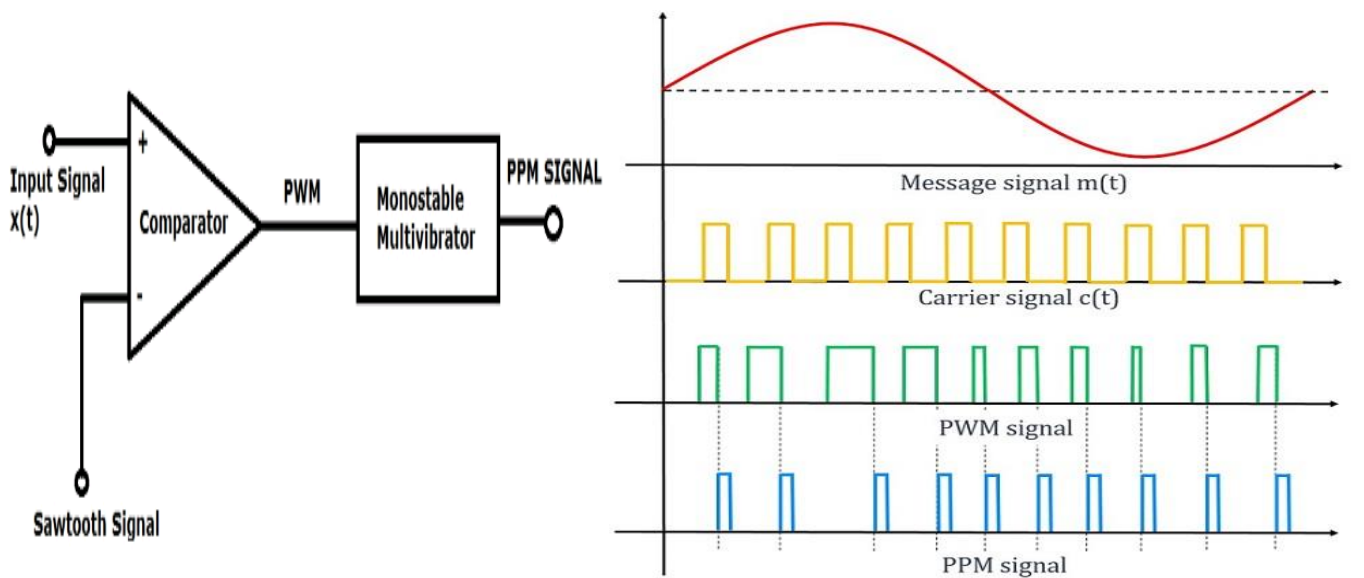**PWM Signal Generation**

Pulse Position Modulation(PWM):

In this type of modulation, both the amplitude and width of the pulse are kept constant. We vary the position of each pulse according to the instantaneous sampled value of the message signal.

PPM signal is further modification of PWM.

Generation of PPM Signal

Waveform representation of PPM signal generation

Electronics Coach

Comparison of PAM,PWM and PPM:

S.No	Pulse Amplitude Modulation (PAM)	Pulse Duration/Width Modulation (PDM/PWM)	Pulse Position Modulation (PPM)
1	Amplitude of the pulse proportional to amplitude of modulating signal	Width of the pulse is proportional to amplitude of modulating signal	The relative position of the pulse is proportional to amplitude of modulating signal
2	Bandwidth of the transmission channel depends on the pulse width	Bandwidth of the transmission channel depends on the rise time of the pulse	Bandwidth of the transmission channel depends on the rising time of the pulse
3	Instantaneous power of the transmitter varies	Instantaneous power of the transmitter varies	Instantaneous power of the transmitter remains constant
4	Noise interference is high	Noise interference is minimum	Noise interference is minimum
5	System is complex to implement	System is simple to implement	System is simple to implement
6	Similar to amplitude modulation	Similar to frequency modulation	Similar to phase modulation