ANALOG SIGNALS

An analog signal is a voltage, current, or physical quantity that continuously and infinitely varies in accordance with some time-varying parameter. For example, radio waves, television waves, or sound waves are all examples of analog signals.

TYPES

- **Continuous-time signals**: Any continuous function of time is considered a continuous-time signal. The most common example is the sinusoid.
- **Discrete-time signals**: Any sequence of real numbers separated by equal time increments (or samples) is considered a discrete-time signal. A common example is the digital audio signal, representing a series of instantaneous amplitudes at equal time increments.

Information obtained from an analog signal

Analog signals contain three types of information:

- Magnitude (or amplitude)
- Frequency
- Phase

Magnitude: The voltage of an AC sine wave is proportional to both its peak-to-peak value as well as its average value. For example, if we had two sine waves with different amplitudes but equal frequencies, they would be indistinguishable on an oscilloscope unless we normalized their amplitudes first. If we divide each voltage measurement by the amplitude of the signal, then we can use voltage as an independent variable.

Frequency: The angular frequency of a waveform is the number of radians per second that it oscillates through, and it can be measured in hertz (cycles per second). For example, if we have two sine waves with different frequencies but equal amplitudes, they would be indistinguishable on an oscilloscope unless we normalized their amplitudes first. If you multiply each frequency by its corresponding normalized amplitude measurement, you can use frequency as an independent variable.

Phase: Phase is how much "behind" or "ahead" of time a waveform is compared to another waveform with the same frequency and magnitude. It can be thought of as how far along in its cycle the waveform is.

DIGITAL SIGNAL

A digital signal is a signal that represents data as a sequence of discrete values. A digital signal can only take on one value from a finite set of possible values at a given time. With digital signals, the physical quantity representing the information can be many things:

- Variable electric current or voltage
- Phase or polarization of an electromagnetic field
- Acoustic pressure
- The magnetization of a magnetic storage media

DIGITAL TO ANALOGE CONVERSION

The following techniques can be used for Digital to Analog Conversion:

1. Amplitude Shift keying – Amplitude Shift Keying is a technique in which carrier signal is analog and data to be modulated is digital. The amplitude of analog carrier signal is modified to reflect binary data.

The binary signal, when modulated, gives a zero value when the binary data represents 0 while gives the carrier output when data is 1. The frequency and phase of the carrier signal remain constant.

2. Frequency Shift keying – In this modulation the frequency of analog carrier signal is modified to reflect binary data.

The output of a frequency shift keying modulated wave is high in frequency for a binary high input and is low in frequency for a binary low input. The amplitude and phase of the carrier signal remain constant.

3. Phase Shift keying – In this modulation the phase of the analog carrier signal is modified to reflect binary data. The amplitude and frequency of the carrier signal remains constant.

ANALOGE TO DIGITAL CONVERSION

PULSE CODE MODULATION:

The most common technique to change an analog signal to digital data is called pulse code modulation (PCM). A PCM encoder has the following three processes:

- Sampling
- Quantization
- Encoding

DELTA MODULATION:

Since PCM is a very complex technique, other techniques have been developed to reduce the complexity of PCM. The simplest is delta Modulation. Delta Modulation finds a change from the previous value. **Modulator –** The modulator is used at the sender site to create a stream of bits from an analog signal. The process records a small positive change called delta. If the delta is positive, the process records a 1 or else the process records a 0. The modulator builds a second signal that resembles a staircase. The input signal is then compared with this gradually made staircase signal.

ADAPTIVE DELTA MODULATION:

The performance of a delta modulator can be improved significantly by making the step size of the modulator assume a time-varying form. A larger step-size is needed where the message has a steep slope of modulating signal, and a smaller step-size is needed where the message has a small slope. The size is adapted according to the level of the input signal. This method is known as adaptive delta modulation (ADM).