# COMMUNICATION SYSTEMS

**Communication System** is a system model describes a communication exchanges between two stations, transmitter and receiver. Signals or information's passes from source to distention through what is called channel, which represents a way that signal use it to move from source toward destination

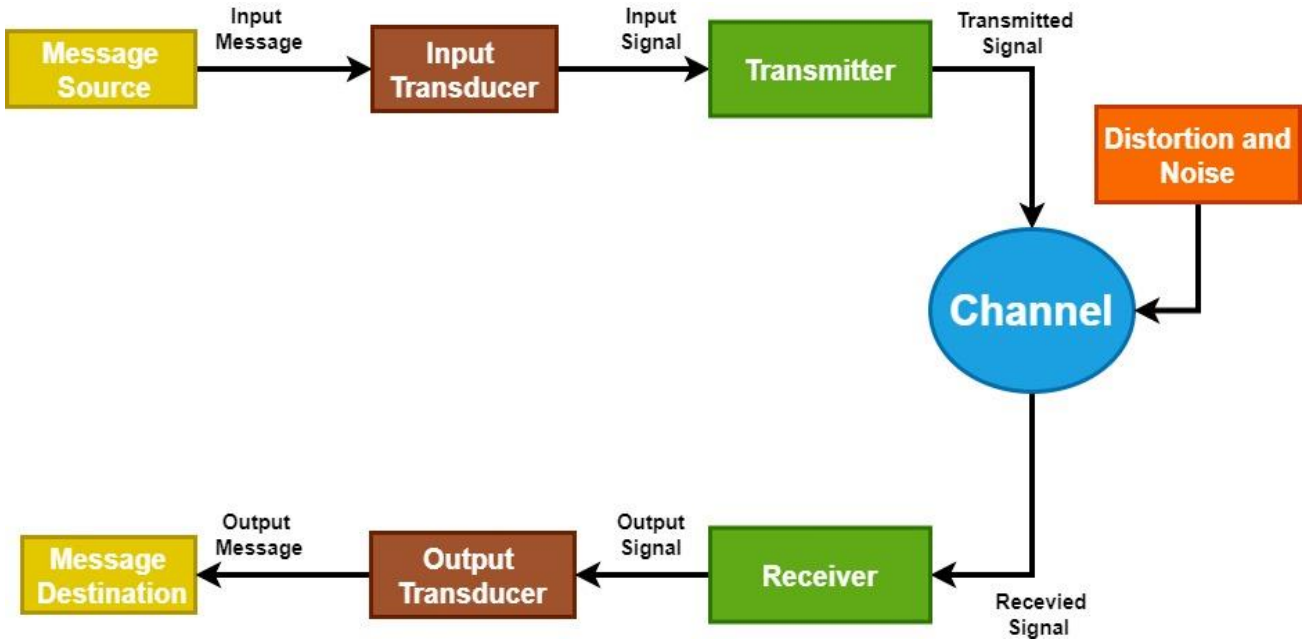



Figure : Communication system

The ***source*** originates a message, such as a human voice, a television picture, an e-mail message, or data. If the data is nonelectric (e.g., human voice, e-mail text, television video), it must be converted by an **input transducer** into an electric waveform referred to as the **baseband signal or message signal** through physical devices such as a microphone, a computer keyboard.

The ***transmitter*** modifies the baseband signal for efficient transmission. The transmitter may consist of one or more subsystems: an *A/D* converter, an encoder, and a modulator. Similarly, the ***receiver*** may consist of a demodulator, a decoder, and a D/A converter.

The ***channel*** is a medium of choice that can convey the electric signals at the transmitter output over a distance. A typical channel can be a pair of twisted copper wires ( telephone and DSL), coaxial cable (television and internet), an optical fiber, or a radio link. Additionally, a channel can also be a point-to-point connection in a mesh of interconnected channels that form a communication network.

The ***receiver*** reprocesses the signal received from the channel by reversing the signal modifications made at the transmitter and removing the distortions made by the channel.

The receiver output is fed to the **output transducer,** which converts the electric signal to its original form-the message.

A channel is a physical medium that behaves partly like a **filter** that generally **attenuates the signal and distorts the transmitted waveforms**. The signal attenuation increases with the length of the channel, varying from a few percent for short distances to orders of magnitude in interplanetary communications. Signal waveforms are distorted because of physical phenomena such as frequency-dependent gains, multipath effects, and Doppler shift. For example, a *frequency-selective* channel causes different amounts of attenuation and phase shift to different frequency components of the signal. A square pulse is rounded or "spread out" during transmission over a low-pass channel. These types of distortion, called **linear distortion,** can be partly corrected at the receiver by an equalizer with gain and phase characteristics complementary to those of the channel.

Channels may also cause **nonlinear distortion** through attenuation that varies with the signal amplitude. Such distortions can also be partly corrected by a complementary equalizer at the receiver.

signals passing through communication channels not only experience channel distortions but also are corrupted along the path by undesirable interferences and disturbances lumped under the broad term **noise.**

# Types of Transmission Media

- **Radio communication**

In radio communication transmission media is open space or free space. In this technique signals are transmitted by using antenna through the free space in the form of EM waves

- **Line communication**

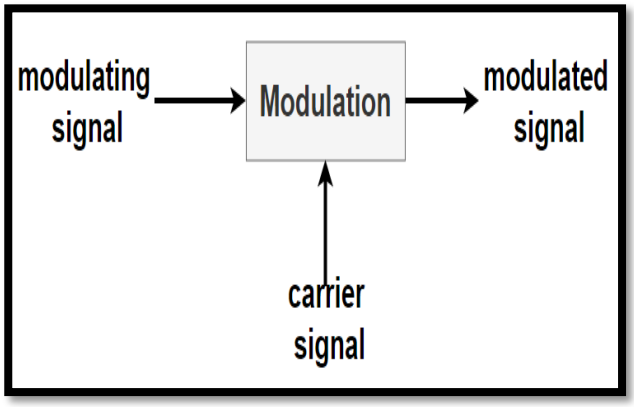
In Line communication the media of transmission is a pair of conductors called transmission line. In this technique signals are directly transmitted through the transmission lines. The installation and maintenance of a transmission line is not only costly and complex, but also overcrowded the open space.

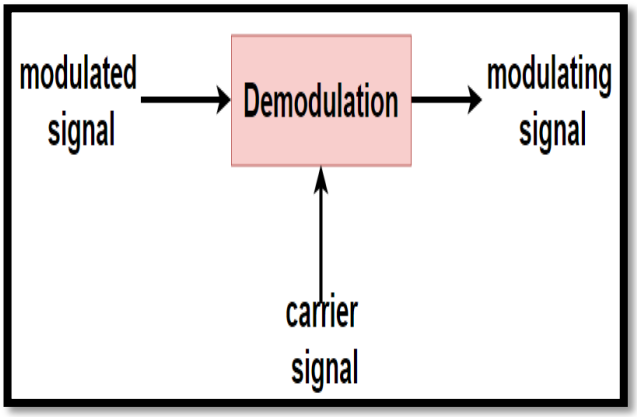
# Modulation and Demodulation (MODEM)

**Modulation:** is a process of mixing a signal with a sinusoid to produce a new signal. This new signal, conceivably, will have certain benefits over an un-modulated signal. Mixing of low frequency signal (information signal) with high frequency signal (carrier signal) is called modulation.

**Demodulation** is the reverse process of modulation, which is used to get back the original message signal. Modulation is performed at the transmitting end whereas demodulation is performed at the receiving end.

In analog modulation sinusoidal signal is used as carrier where as in digital modulation pulse train is used as carrier.




# Communication System Classified

The communication classified into two groups depend on the range to transmit information

### 1- Baseband System

Baseband transmission sends the information signal as it is without modulation (without frequency shifting).

### 2- Bandpass System

Passband transmission shifts the signal to be transmitted to a higher frequency and then transmits it. At the receiver the signal is shifted back to its original frequency.

Almost all sources of information generate baseband signals. Baseband signals are those that have frequencies relatively close to zero such as the human voice (20 Hz-20kHz).

# Why Using Modulation

1. Reduce the size of antenna
2. Frequency assignment
3. Multiplexing
4. Increase the range of communication
5. Reduce noise and interference

# Type of Modulation

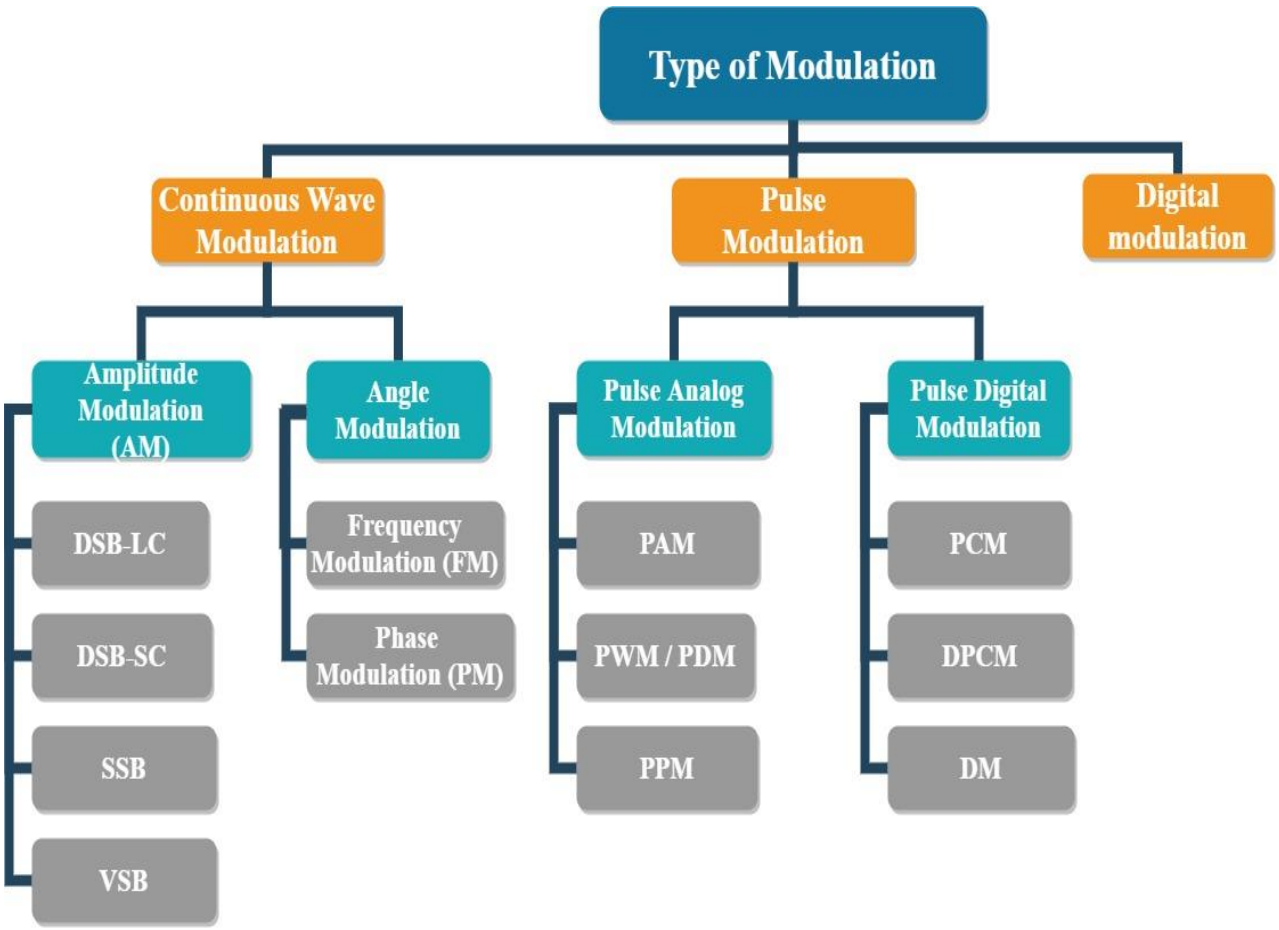



Figure: Flowchart type of modulation

# Classification of Signals

There are various classes of signals. which are suitable for the scope of this lecture.
1. Continuous time and discrete time signals
2. Analog and digital signals

## 1. Continuous time and discrete time signals

A signal that is specified for every value of time $t$ (Fig. a) is a **continuous time signal,** and a signal that is specified only at discrete points of $t = nT$ (Fig. b) is a **discrete time signal.**

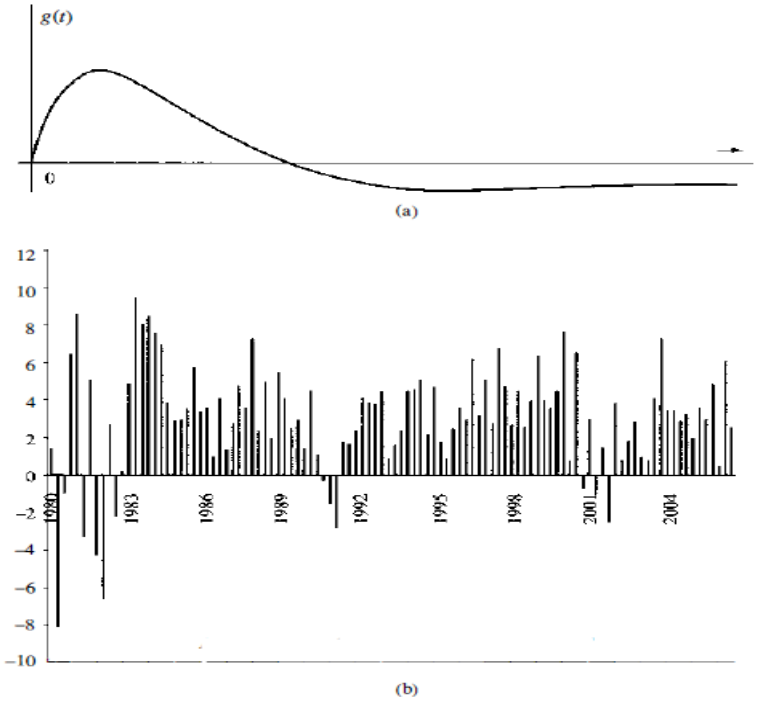



Figure : (a) Continuous time signal (b) Discrete time signals

## 2. Analog and digital signals

One should not confuse analog signals with continuous time signals. The two concepts are not the same. This is also true of the concepts of discrete time and digital. A signal whose amplitude can take on any value in a continuous range is an ***analog signal***. This means that an analog signal amplitude can take on an infinite number of values. A ***digital signal***, on the other hand, is one whose amplitude can take on only a finite number of values. Signals associated with a digital computer are digital because they take on only two values zero or one(binary signals).

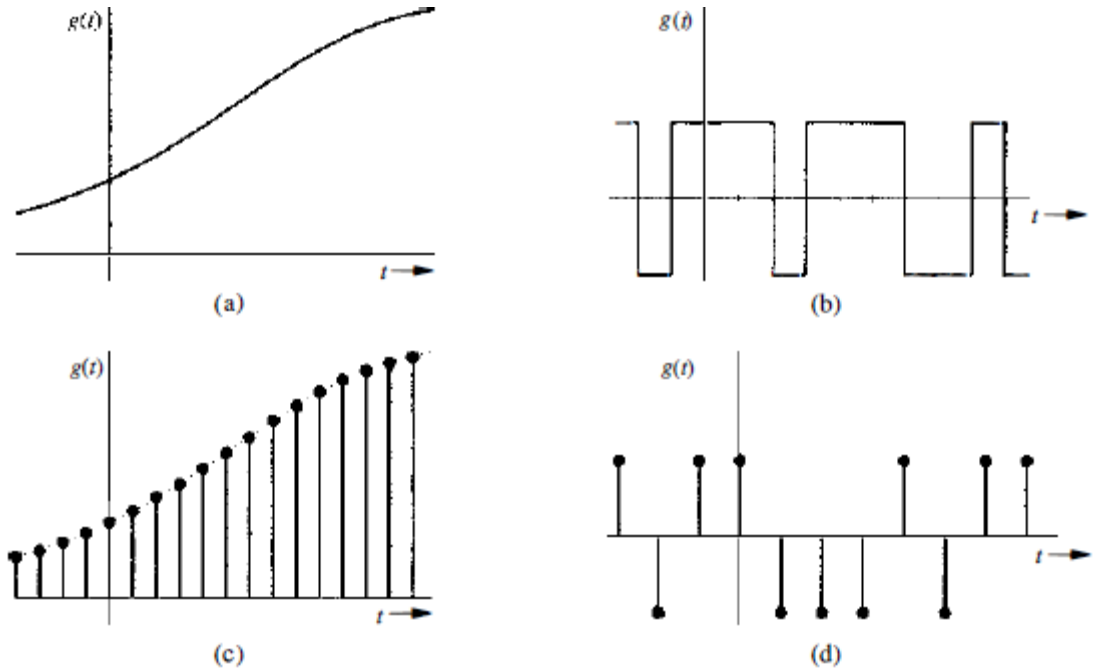



Figure : Examples of signals: (a) analog and continuous time, (b) digital and continuous time, (c) analog and discrete time, (d) digital and discrete time.