Al-Mustaqbal University
Department of Medical Instrumentation Techniques Engineering
Class: Third
Subject: Medical Communication Syatems
Lecturer: Prof. Dr. Bayan Mahdi Sabbar & Dr. Mayasah Razzaq Abd-Ali
Lecture:7

Lecture 7

Digital Modulation

7.1 Introduction

Digital modulation is the process of encoding a digital information signal into the amplitude, phase, or frequency of the transmitted signal. The encoding process affects the bandwidth of the transmitted signal and its robustness to channel impairments. Analog modulation refers to the process of transferring digital low frequency baseband signal, like digital bitstream from computers over a higher frequency carrier signal such as a radio frequency band. Digital modulation in somewhat similar to the analog modulation except base band signal is of discrete amplitude level. For binary signal it has only two level, either high or logic 1 or low or logic 0. The modulation scheme is mainly three types.

1. ASK or Amplitude shift Key
2. FSK or Frequency shift key
3. PSK or Phase shift key

7.2 The Advantages of Digital Modulation:

Information capacity, data security, communication quality, and system availability are properties of digital modulation that make it more advantageous than analog modulation. Other advantages of digital modulation include:

• High capacity for data transmission - the amount of data transmitted through digital modulation is more than through analog communication.

• Incredible bandwidth efficiency - it can accommodate large amounts of data within a limited bandwidth.

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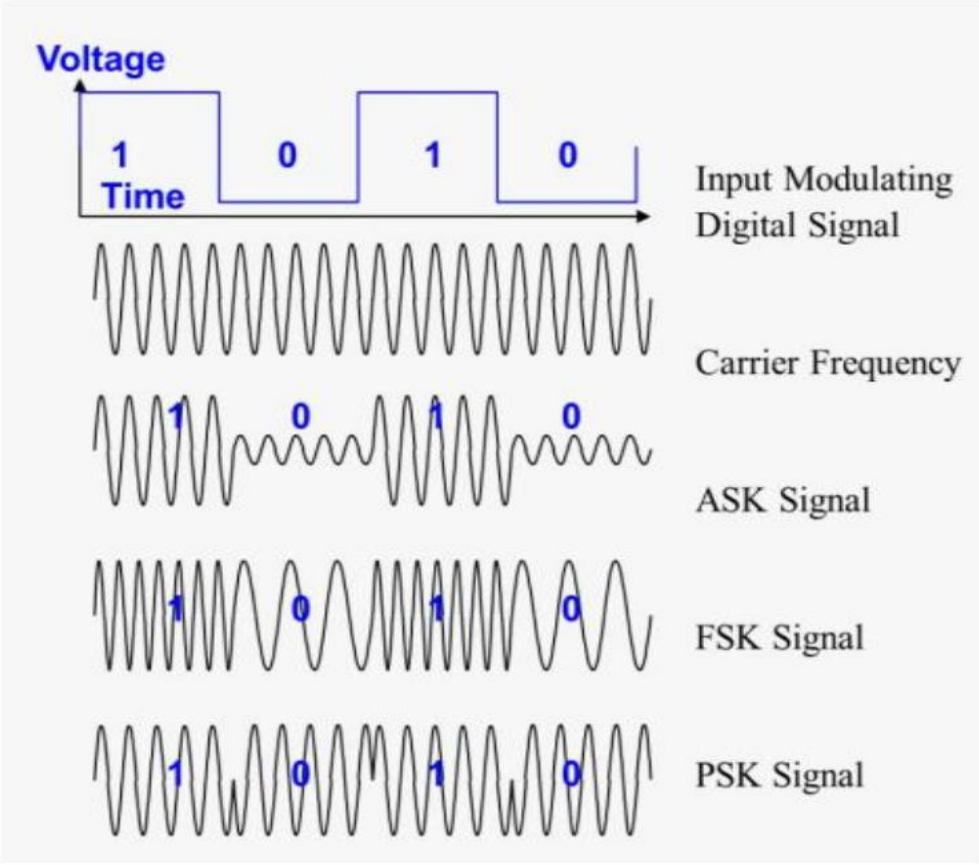
• Flexible signals - there is an opportunity to multiplex various forms of data such as digital information, video, and voice.

• Less susceptibility to crosstalk, waveform distortion, non-linearities, and noise.

• Enhanced signal strength, which prevents unwanted signal and communication noises.

• It is the cheapest option while interfacing with digital switching systems.

Enhanced data security - the easy encryption and decryption of digital signals with high security make it suitable for sensitive and reliable communication



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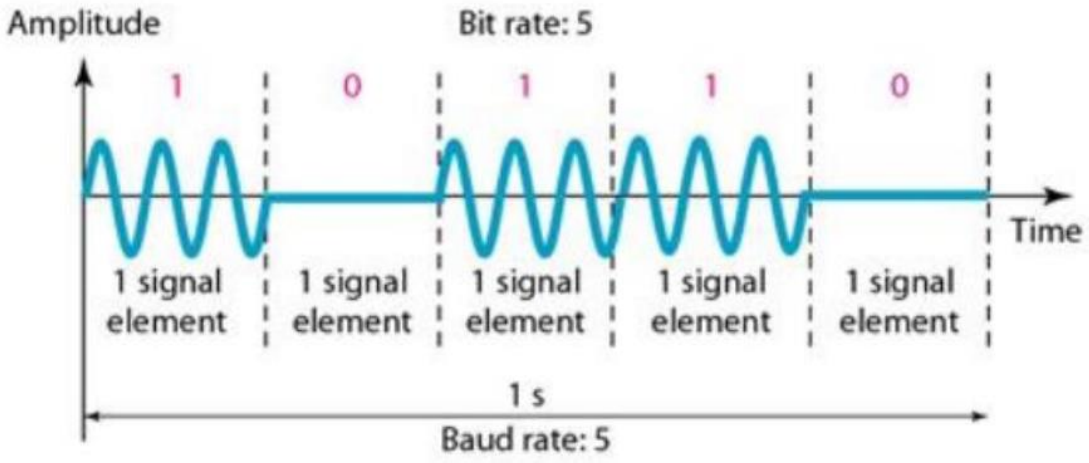
7.3 ASK or Amplitude shift Key:

When the carrier signal's instantaneous amplitude is varied in proportion to message signal m(t). We have the modulated carrier m(t)cos wct where cos wct is the carrier signal. In amplitude shift keying, the amplitude of the carrier signal is varied to create signal elements. Both frequency and phase remain constant while the amplitude changes. ASK is normally implemented using only two levels. This is referred to as binary amplitude shift keying or on-off keying (OOK). The peak amplitude of one signal level is 0; the other is the same as the amplitude of the carrier frequency. The following figure gives a conceptual view of binary ASKS.

Application:

• Used in our infrared remote controls. • Used in fiber optical transmitter and receiver.



7.4 FSK or Frequency shift keying:

When Data are transmitted by varying instantaneous frequency of the carrier, we have the case of frequency shift key. In frequency shift keying, the frequency of the carrier signal is varied to represent data. The frequency of the modulated signal

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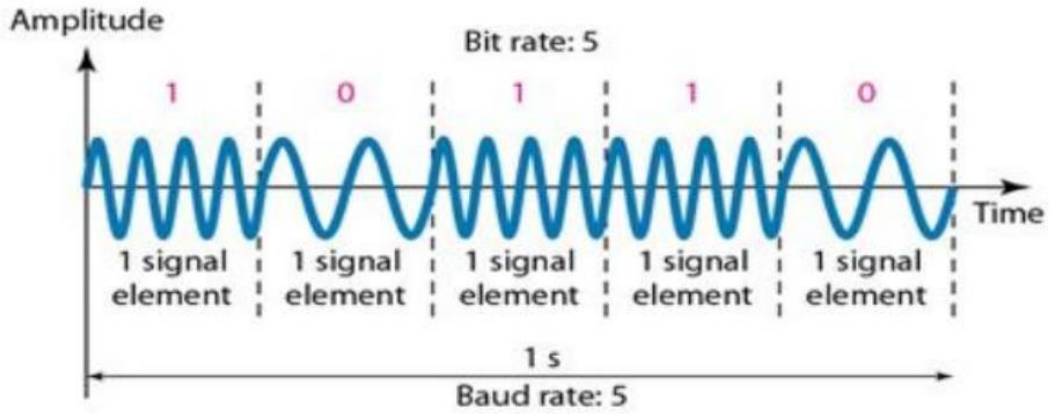
is constant for the duration of one signal element, but changes for the next signal element if the data element changes. Both peak amplitude and phase remain constant for all signal elements. One way to think about binary FSK (or BFSK) is to consider two carrier frequencies. In the following Figure, we have selected two carrier frequencies f1 and f2. We use the first carrier if the data element is 0; we use the second if the data element is 1. **Application:** Many modems used FSK in telemetry systems.



7.5 PSK or Phase shift keying :

In phase shift keying, the phase of the carrier is varied to represent two or more different signal elements. Both peak amplitude and frequency remain constant as the phase changes. The simplest PSK is binary PSK, in which we have only two signal elements, one with a phase of 0°, and the other with a phase of 180°. The following figure gives a conceptual view of PSK. Binary PSK is as simple as binary ASK with one big advantage-it is less susceptible to noise. In ASK, the criterion for bit detection is the amplitude of the signal. But in PSK, it is the phase. Noise can change the amplitude easier than it can change the phase. In other

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words, PSK is less susceptible to noise than ASK. PSK is superior to FSK because we do not need two carrier signals.

Applications:

• This method is broadly used for bio-metric, wireless LAN along with wireless communications like Bluetooth and RFID. • Local Oscillator • Optical Communications • Multi-channel WDM