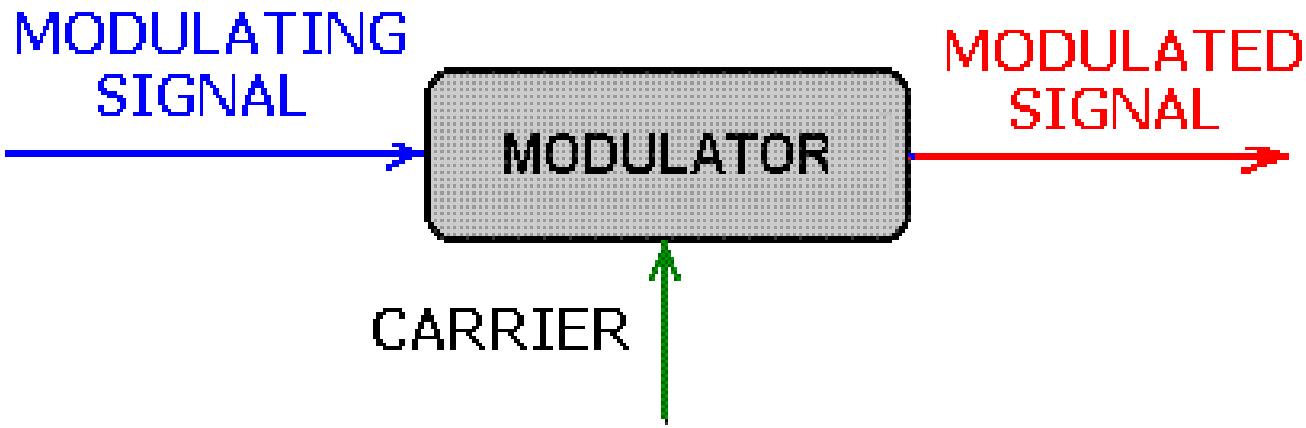
Analog and Digital Modulation Techniques

Modulation

- **Modulation** The transmitter modifies the message signal into a form suitable for transmission over the channel.
- **The modulation process involve two waves:**
- The baseband signal (called a **Modulating Signal**) and the **Carrier Signal** which is a sinusoid signal.
- The output of the modulation process is called as the **Modulated Signal.**

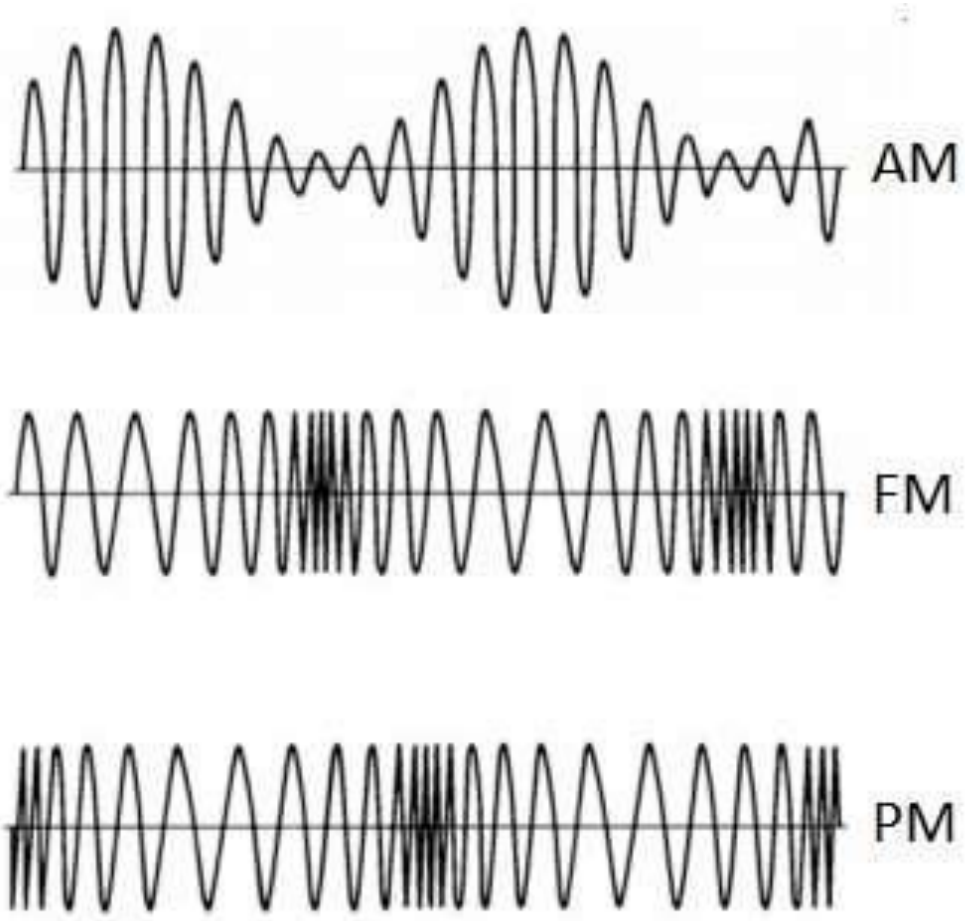
Modulation



Classification of Modulation Techniques

Sr. No.	Modulation Techniques	Type	Notation
01	Analog Modulation Techniques	(i) Amplitude Modulation	A.M.
		(ii) Frequency Modulation	F.M.
		(iii) Phase Modulation	P.M.
02	Digital Modulation Techniques	(i) Amplitude Shift Keying	A.S.K.
		(ii) Frequency Shift Keying	F.S.K.
		(iii)Phase Shift Keying	P.S.K.

Table-1: Type of Modulation Techniques


AM
FM
PM

Analog Modulation Techniques

- **There are basically three type of analog modulation; schemes the amplitude modulation, the Frequency modulation and the phase modulation schemes which have in turn lot of class.**

- **In case of the Amplitude Modulation there are several derivatives.**

Classification of Analog Modulation Techniques

Sr. No.	MODULATION TECHNIQUES	REPRESENTATION	TYPE
1	Amplitude Modulation Double-Sideband Suppressed Carrier	AM DSB-SC	Linear
2	Amplitude Modulation Double-Sideband With Full Carrier	AM DSB-FC	Linear
3	Amplitude Modulation Single-Sideband Suppressed Carrier	AM SSB-SC	Linear
4	Amplitude Modulation Single-Sideband With Full Carrier	AM SSB-FC	Linear
5	Amplitude Modulation Vestigial-Sideband	AM VSB	Linear
6	Narrow-Band Frequency Modulation	NBFM	Non-Linear
7	Wide-Band Frequency Modulation	WBFM	Non-Linear
8	Phase Modulation	PM	Non-Linear

Table-2: Classification of Analog Modulation Techniques

Digital Modulation Techniques

- **Provides more information capacity, high data security, quicker system availability with great quality communication.**

- **There are many types of digital modulation techniques.**

1- ASK (Amplitude Shift Keying)

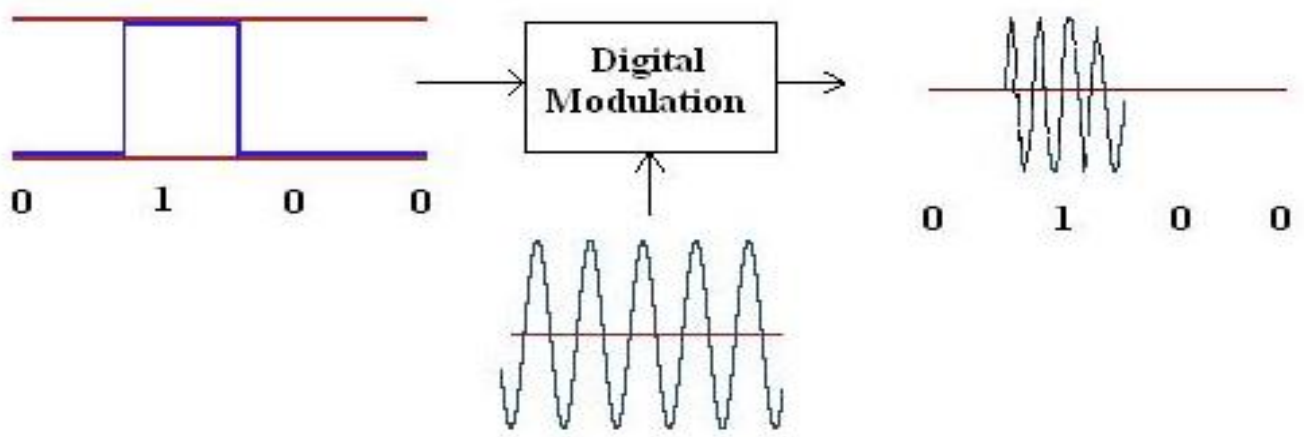
- **Amplitude Shift Keying (ASK)** is a type of Amplitude Modulation which represents the binary data in the form of variations in the amplitude of a signal.

- 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.

1- ASK (Amplitude Shift Keying)

- The following figure represents ASK modulated waveform along with its input.



- ASK modulation can be <u>represented by following equation:</u>
- **s(t) =** $A\cos(2\pi f_c t)$ <u>for Binary 1</u>
- **s(t) = 0** <u>for Binary 0</u>

1- ASK (Amplitude Shift Keying)

- **Advantage:**
- Simplicity.
- **Disadvantage:**
- ASK is very susceptible to noise interference; noise usually (only) affects the amplitude, therefore ASK is the modulation technique most affected by noise.
- **Application:**
- ASK is used to transmit digital data over optical fiber.

2- FSK (Frequency Shift Keying)

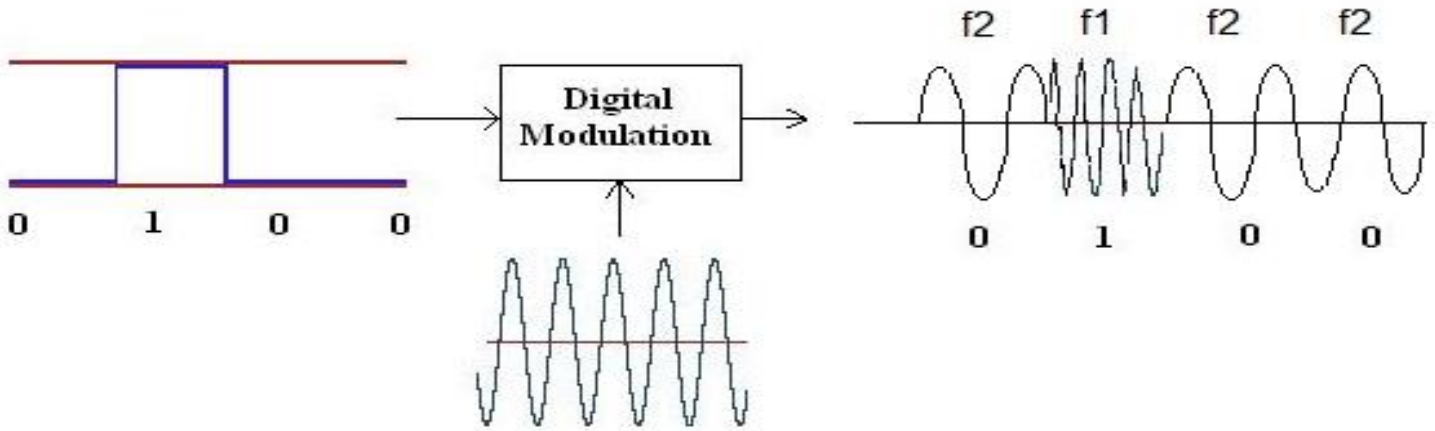
- **Frequency Shift Keying (FSK)** the frequency of the output signal will be either high or low, depending upon the input data applied.

- Binary 1 and 0 is represented by two different carrier frequencies.

- Figure depicts that binary 1 is represented by high frequency 'f1' and binary 0 is represented by low frequency 'f2'.

2- FSK (Frequency Shift Keying)

- **The following figure represents FSK modulated waveform along with its input.**



- **Binary FSK can be <u>represented by following equation:</u>**
- **s(t) = A*cos(2*π*f1*t) <u>for Binary 1</u>**
- **s(t) = A*cos(2*π*f2*t) <u>for Binary 0</u>**

2- FSK (Frequency Shift Keying)

Advantage:

- FSK is less susceptible to errors than ASK ; receiver looks for specific frequency changes over a number of intervals, so voltage (noise) spikes can be ignored.

Disadvantage:

- FSK spectrum is 2 x ASK spectrum.

Application:

- Over voice lines, in high-freq. radio transmission, etc.

3- PSK (Phase Shift Keying)

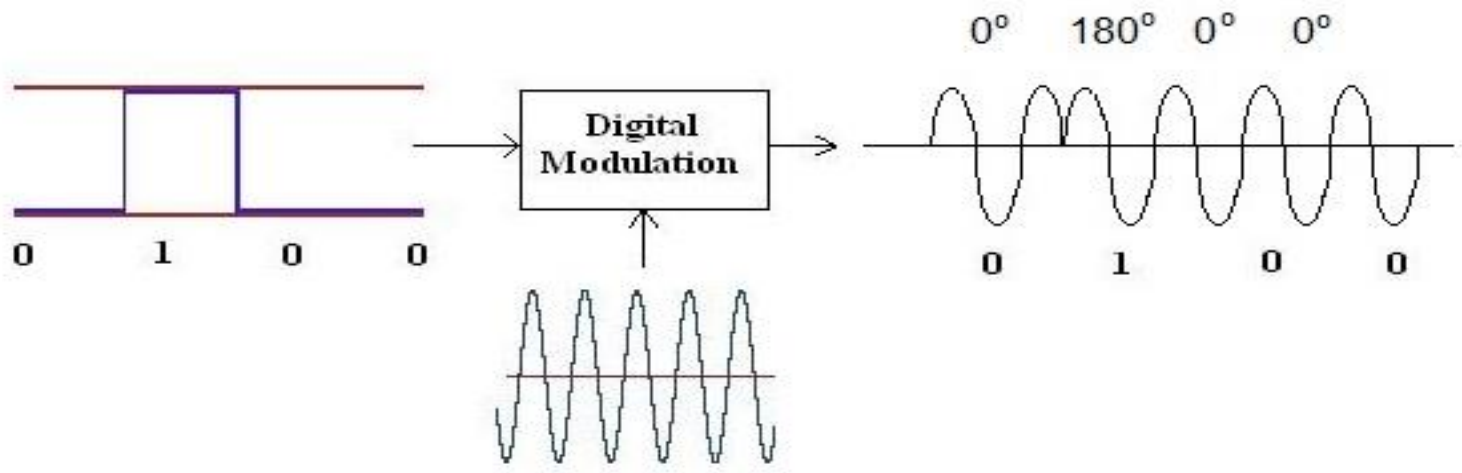
- **Phase Shift Keying (PSK)** **The phase of the output signal gets shifted depending upon the input.**

- **These are mainly of two types, namely Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK), according to the number of phase shifts.**

- **Binary 1 is represented by 180 degree phase of the carrier and binary 0 is represented by 0 degree phase of the RF carrier.**

3- PSK (Phase Shift Keying)

- **The following figure represents PSK modulated waveform along with its input.**



- **Binary FSK can be <u>represented by following equation:</u>**
- **s(t) = A*cos(2*π*fc*t) <u>for Binary 1</u>**
- **s(t) = A*cos(2*π*fc*t + π) <u>for Binary 0</u>**

3- PSK (Phase Shift Keying)

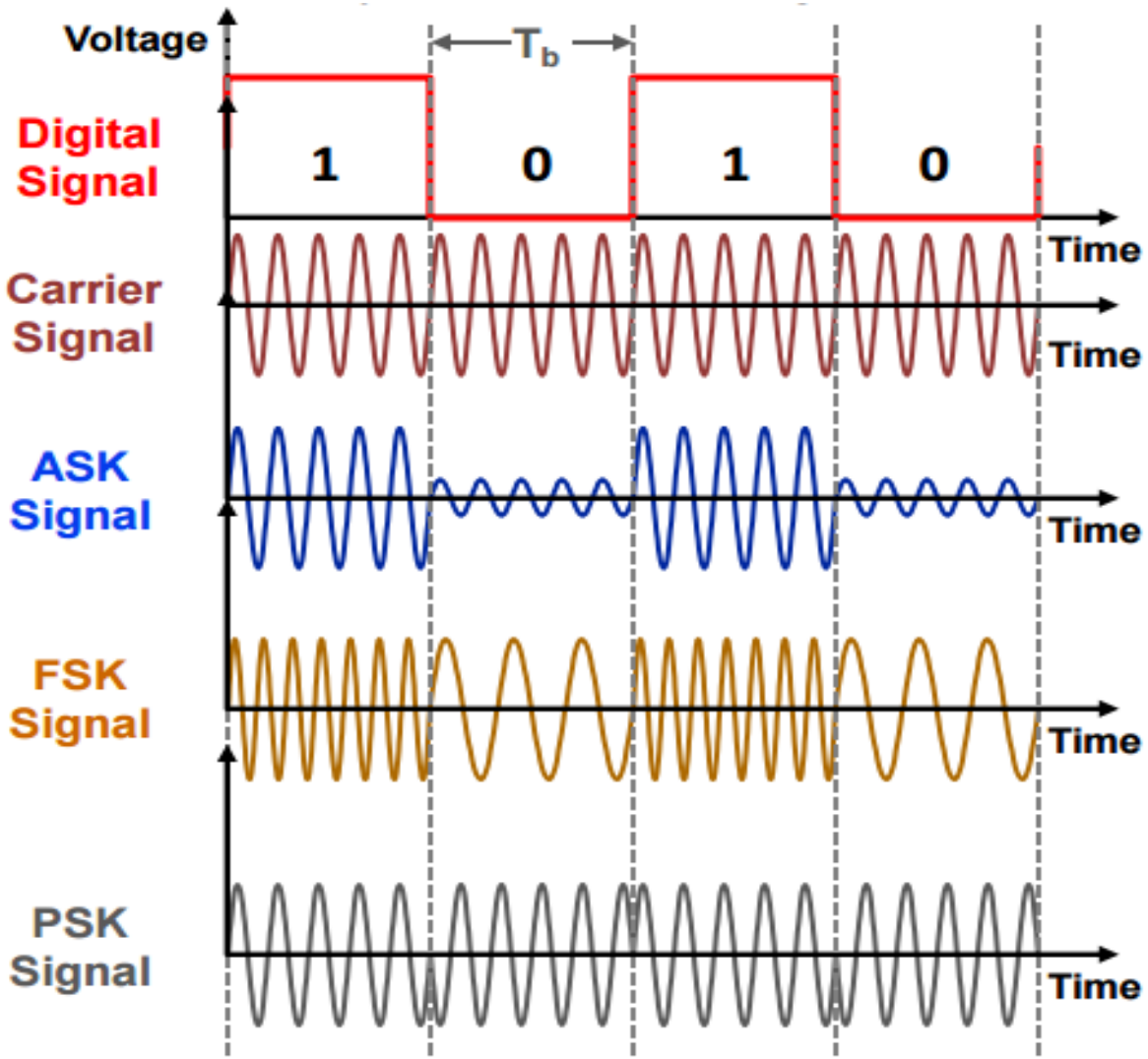
Advantage:

- PSK is less susceptible to errors than ASK, while it requires/occupies the same bandwidth as ASK.
- More efficient use of bandwidth (higher data-rate) are possible, compared to FSK.

Disadvantage:

- More complex signal detection / recovery process, than in ASK and FSK

Comparison between ASK, FSK and PSK



Any Questions?