SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution

Coimbatore-35

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB301-ANALOG AND DIGITAL COMMUNICATION

III YEAR/ V SEMESTER

UNIT 4 – DIGITAL MODULATION TECHNIQUES

TOPIC – Modulation techniques

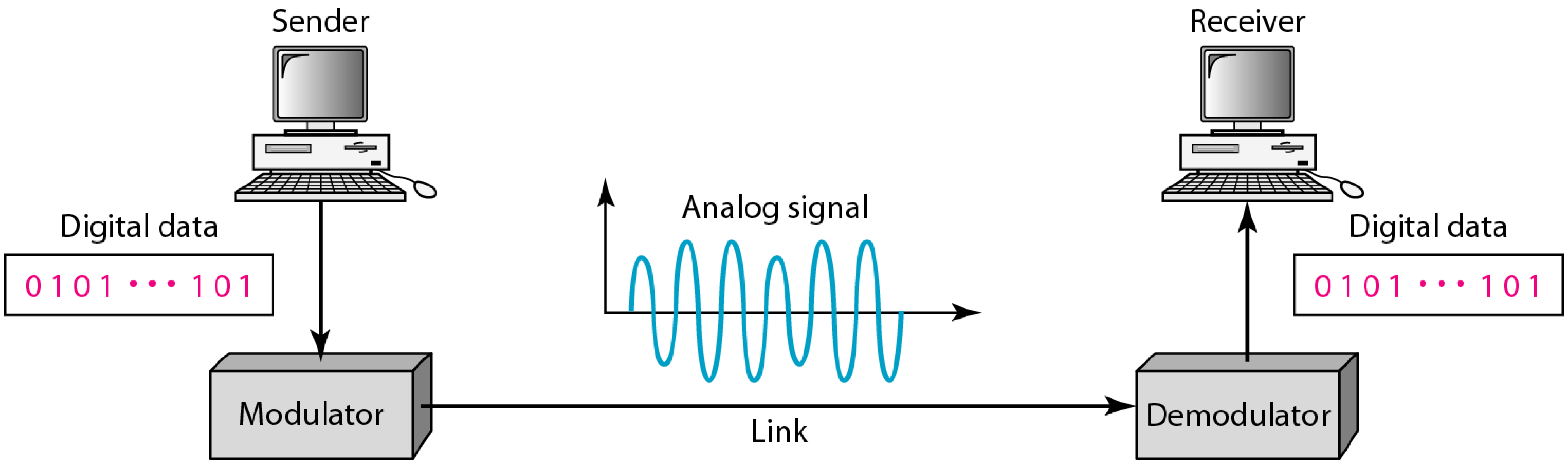
Digital To Analog Conversion

- **Digital-to-analog** conversion is the process of changing one of the characteristics of an analog signal based on the information in digital data.

- Topics discussed in this section:
  1. Aspects of Digital-to-Analog Conversion
  2. Amplitude Shift Keying
  3. Frequency Shift Keying
  4. Phase Shift Keying
  5. Quadrature Amplitude Modulation

Digital-to-analog conversion

- Digital-to-analog conversion is the process of changing one of the characteristics of an analog signal (carrier signal) based on the information in digital data.



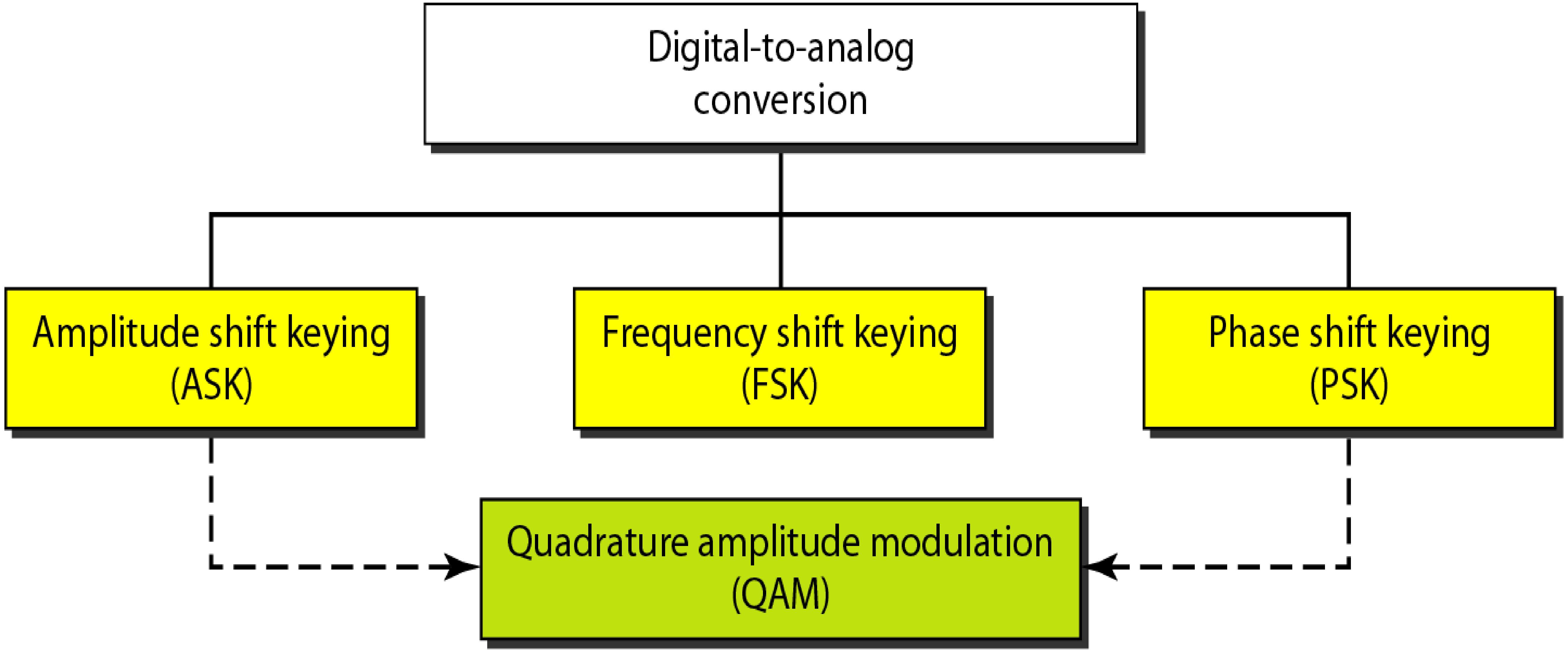
Digital /Analog converter

Analog /Digital converter

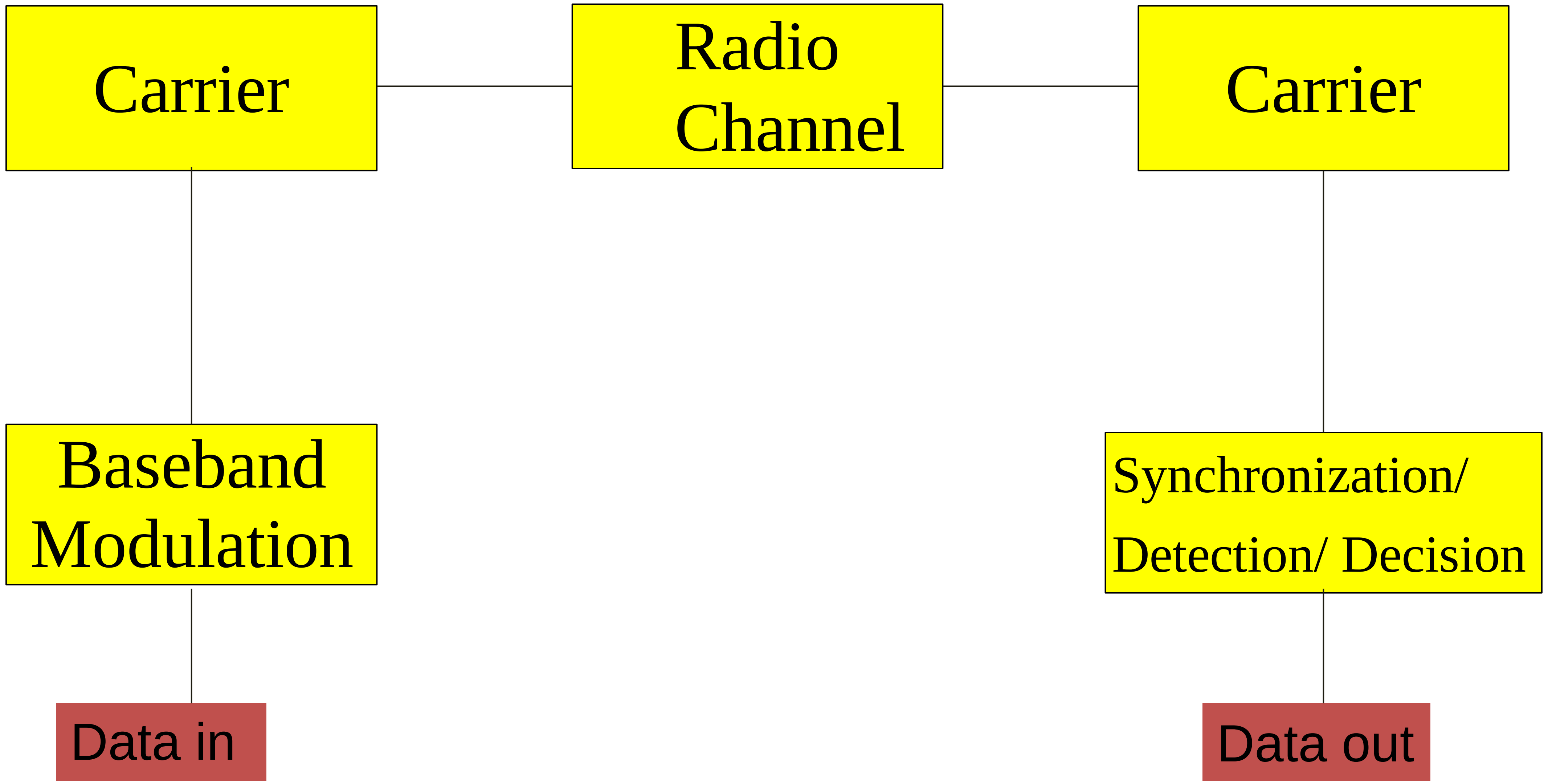
Why we need digital modulation

- Digital modulation is required if digital data has to be transmitted over a medium that only allows analog transmission.
  - Modems in wired networks.
  - Wireless must use analogue sine waves.

Types of digital-to-analog conversion

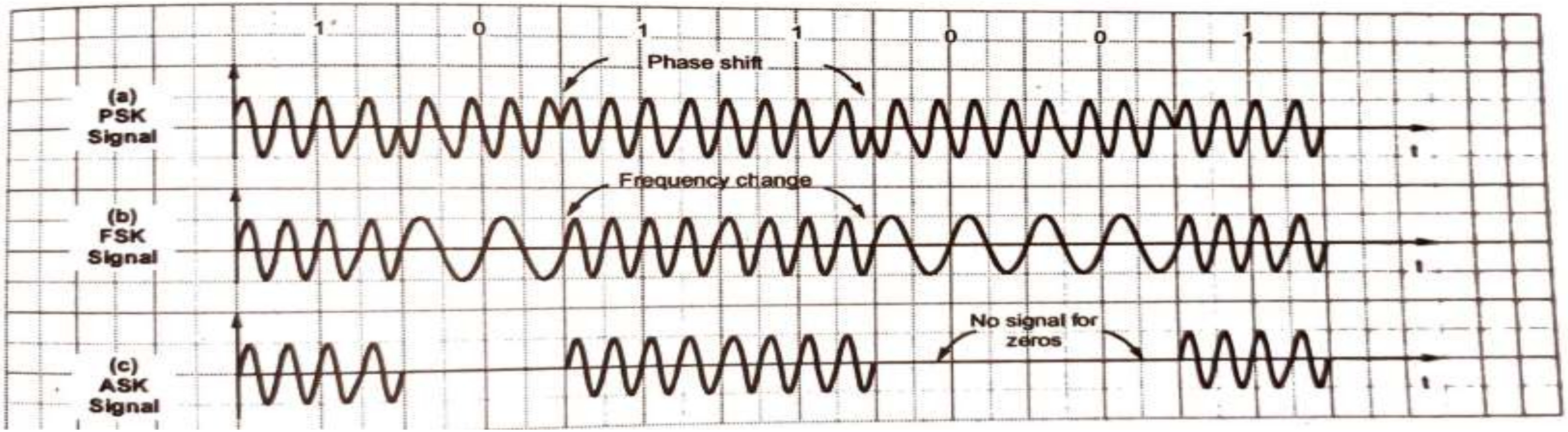


Modulation & Demodulation



Modulation techniques

1) **Phase Shift Keying (PSK)** : In this technique, the digital data modulates phase of the carrier.
2) **Frequency Shift Keying (FSK)** : In this technique, the digital data modulates frequency of the carrier.
3) **Amplitude Shift Keying (ASK)** : In this technique, the digital data modulates amplitude of the carrier.



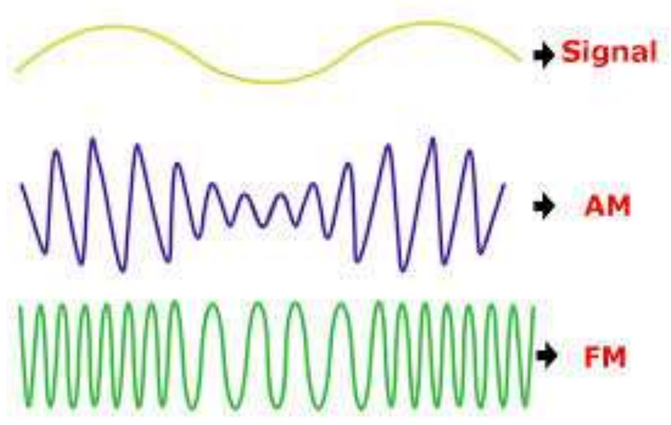
Modulation

- Modulation :

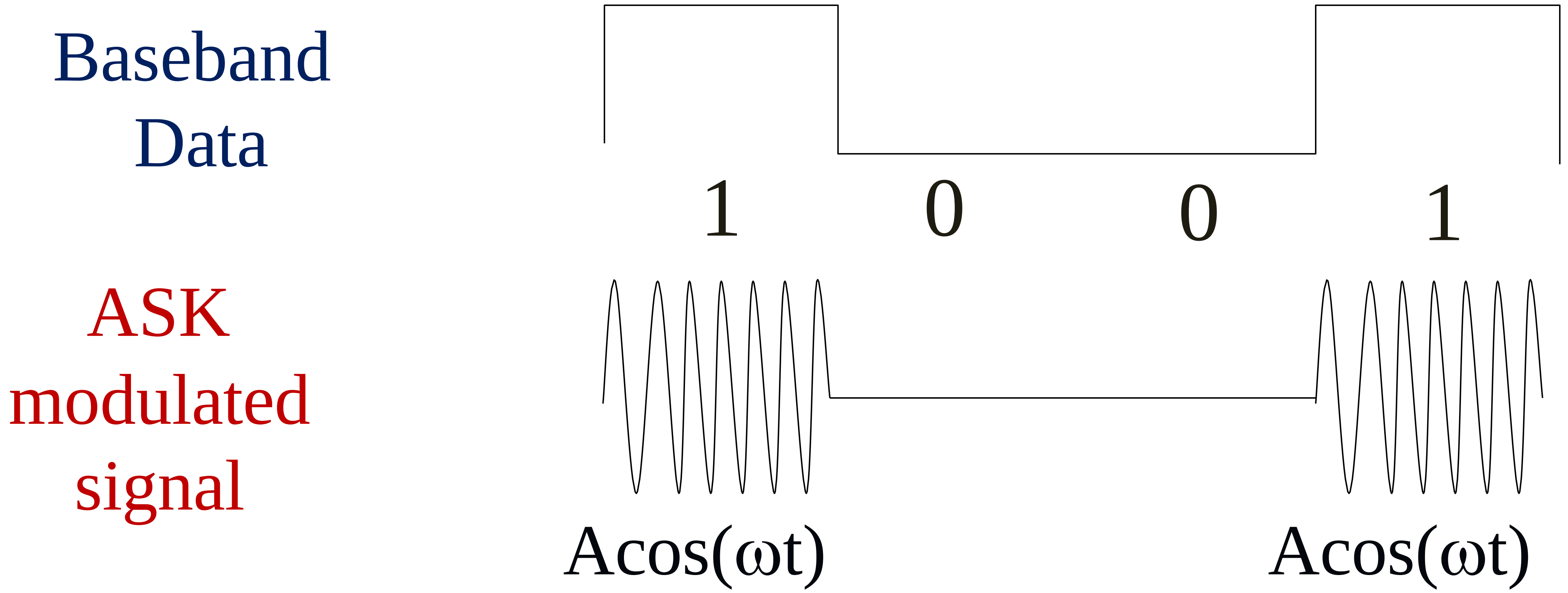
  process (or result of the process) of translation the baseband message signal to bandpass (modulated carrier) signal at frequencies that are very high compared to the baseband frequencies.

- Demodulation is the process of extracting the baseband message back the modulated carrier.

- An information-bearing signal is non- deterministic, i.e. it changes in an unpredictable manner.



Amplitude Shift Keying(ASK)



- Pulse shaping can be employed to remove spectral spreading
- ASK demonstrates poor performance, as it is heavily affected by noise, fading, and interference

Pros and Cons

- **Pros**:

ASK transmitter and receiver are simple to design.

ASK needs less bandwidth than FSK.

- **Cons**:

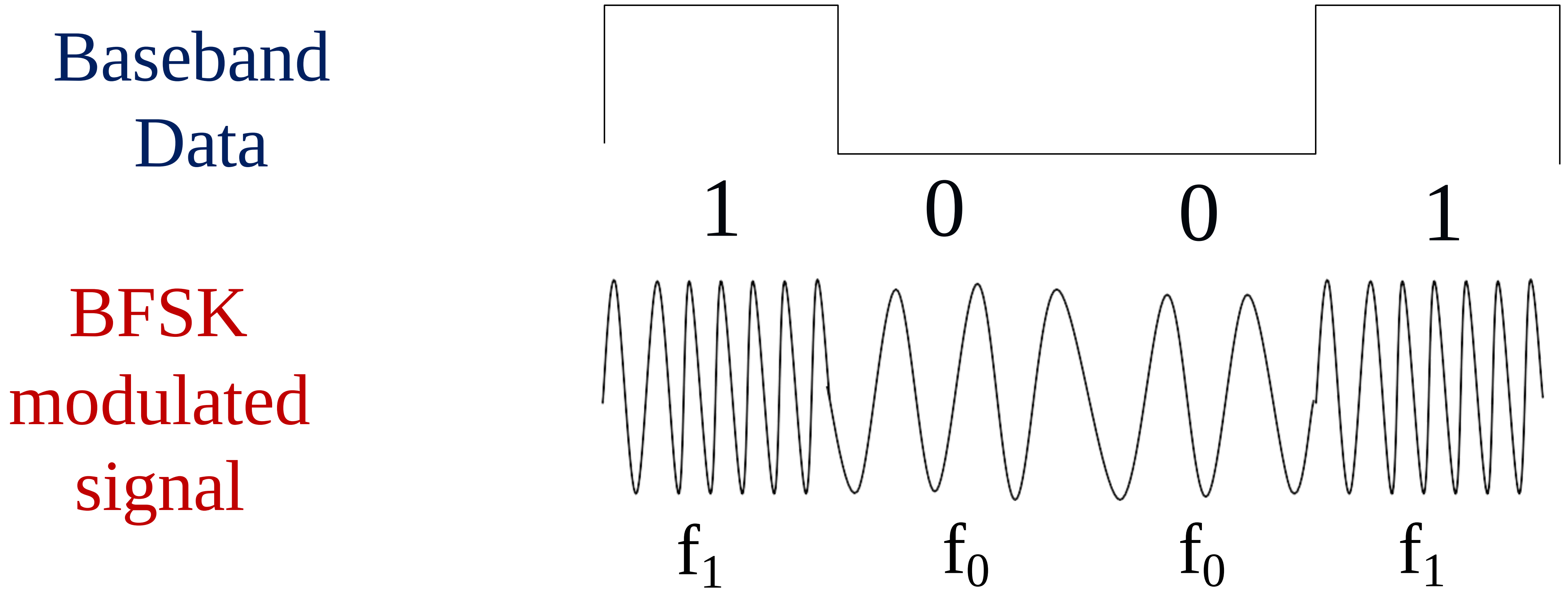
ASK transmission can be easily corrupted by noise.

- **Application**:

Early telephone modem (AFSK).

ASK is used to transmit digital data over optical fiber.

Frequency Shift Keying (FSK)

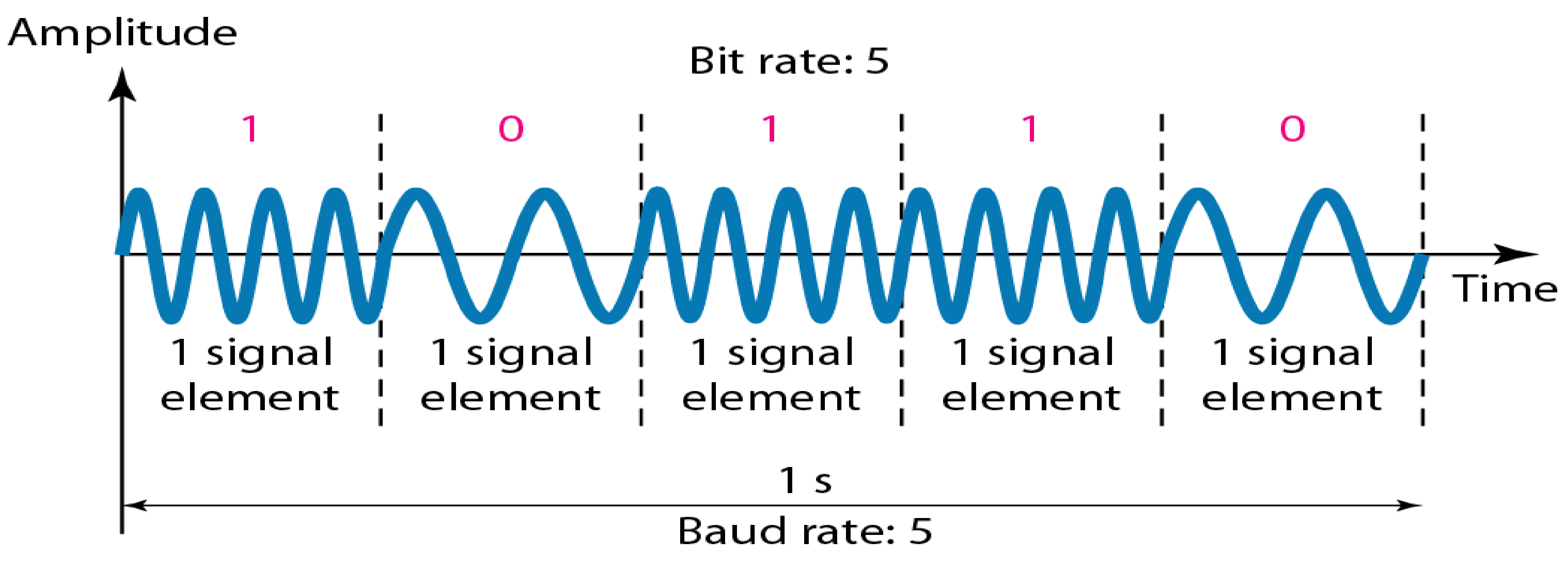


where $f_0 = A\cos(\omega_c - \Delta\omega)t$ and $f_1 = A\cos(\omega_c + \Delta\omega)t$

- **Example**: The ITU-T V.21 modem standard uses FSK
- FSK can be expanded to a M-ary scheme, employing multiple frequencies as different states

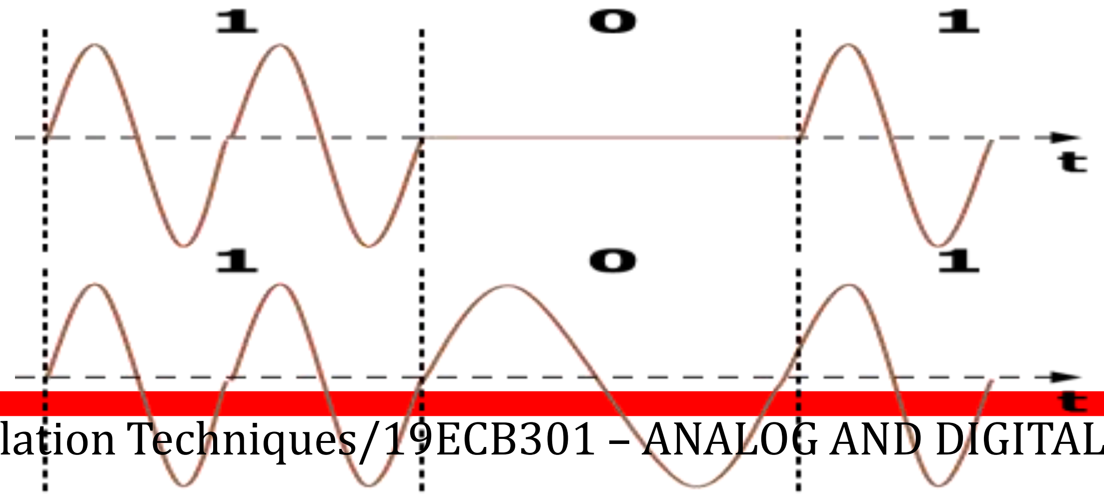
FSK (Frequency Shift Keying)

- The frequency of the carrier signal is varied to represent binary **1** or **0**.
- Both peak amplitude and phase remain constant while the frequency changes.
- The frequency of the signal during each bit duration is constant, and its value depends on the bit (0 or 1).



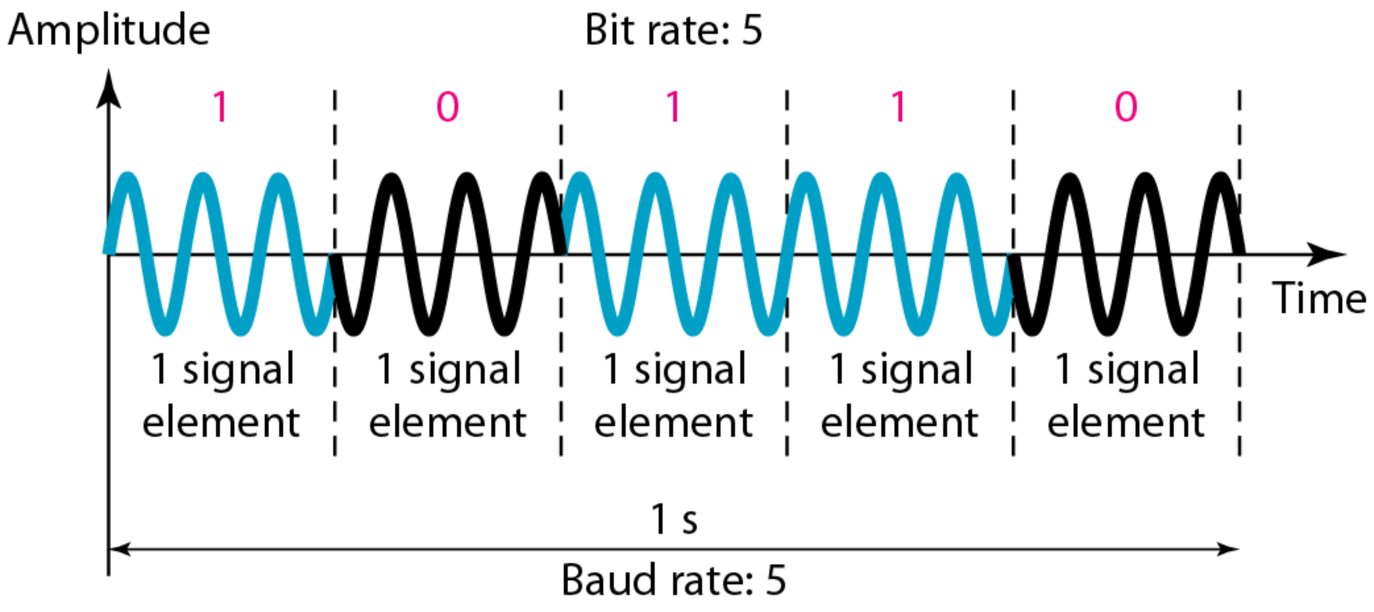
ASK and FSK

Amplitude Shift Keying (ASK)	Frequency Shift Keying (FSK)
• Very simple.	• Needs larger bandwidth.
• Low bandwidth requirements.	• More error resilience than AM.
• Very susceptible to interference	



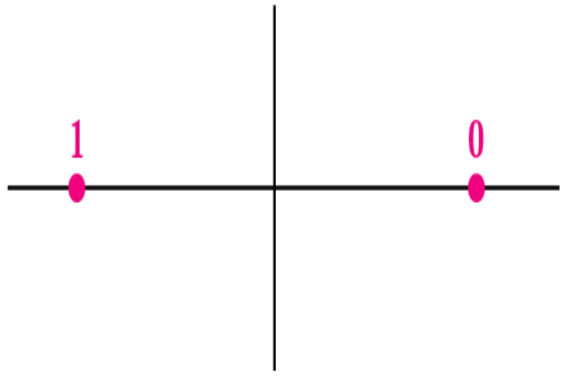
Phase Shift Keying

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).
In binary PSK, we have only two signal elements: one with a phase of 0°, and the other with a phase of 180°.



Bit	Phase
0	0
1	180

Bits

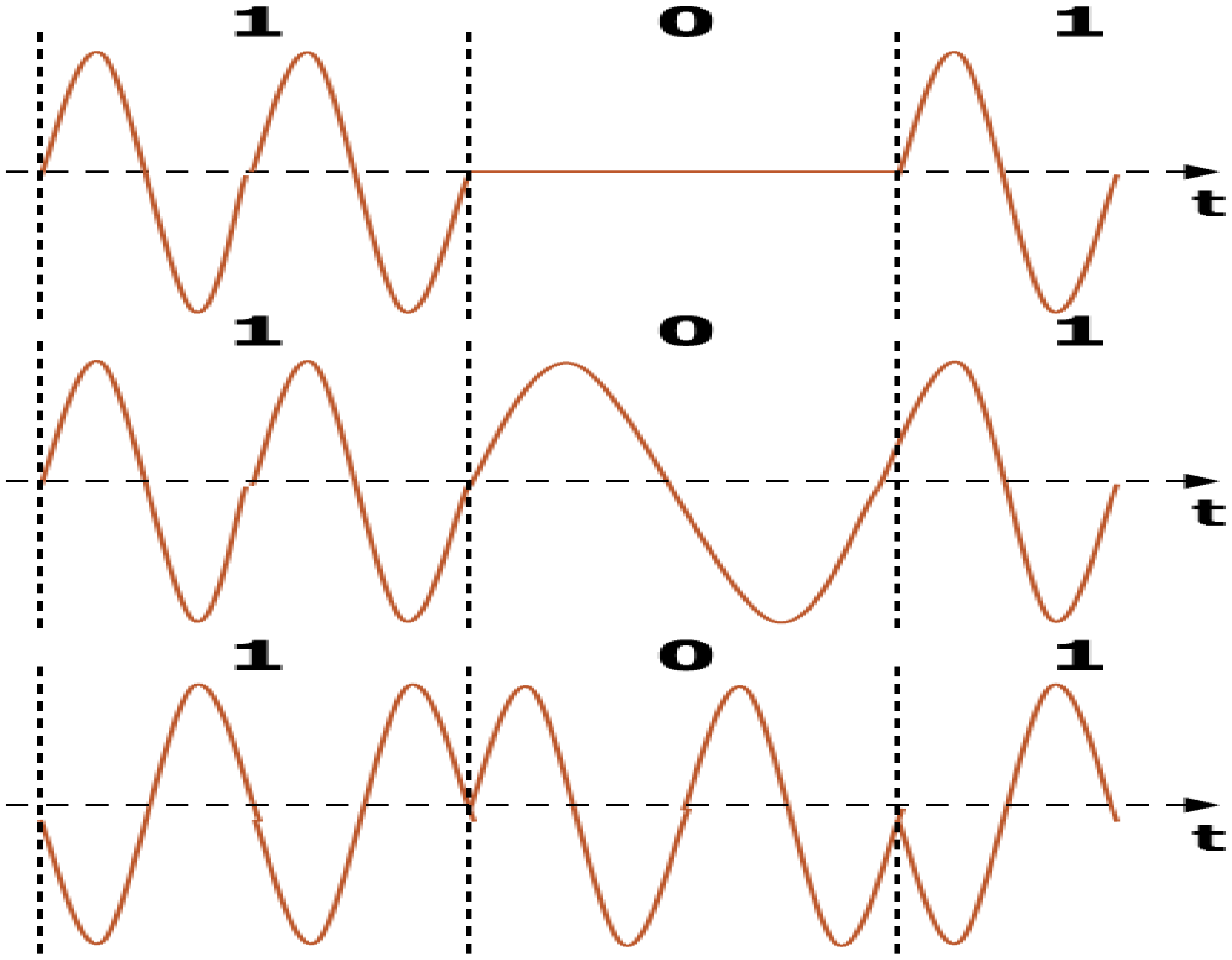


Constellation diagram

Digital Modulation Summary

Amplitude Shift Keying (ASK)	Frequency Shift Keying (FSK)	Phase Shift Keying (PSK)
• Very simple.	• Needs larger bandwidth.	• More complex.
• Low bandwidth requirements	• More error resilience than AM.	• Robust against interference.
• Very susceptible to interference		

Digital Modulation Summary



THANK YOU