SNS COLLEGE OF TECHNOLOGY

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Coimbatore-35

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB301-ANALOG AND DIGITAL COMMUNICATION

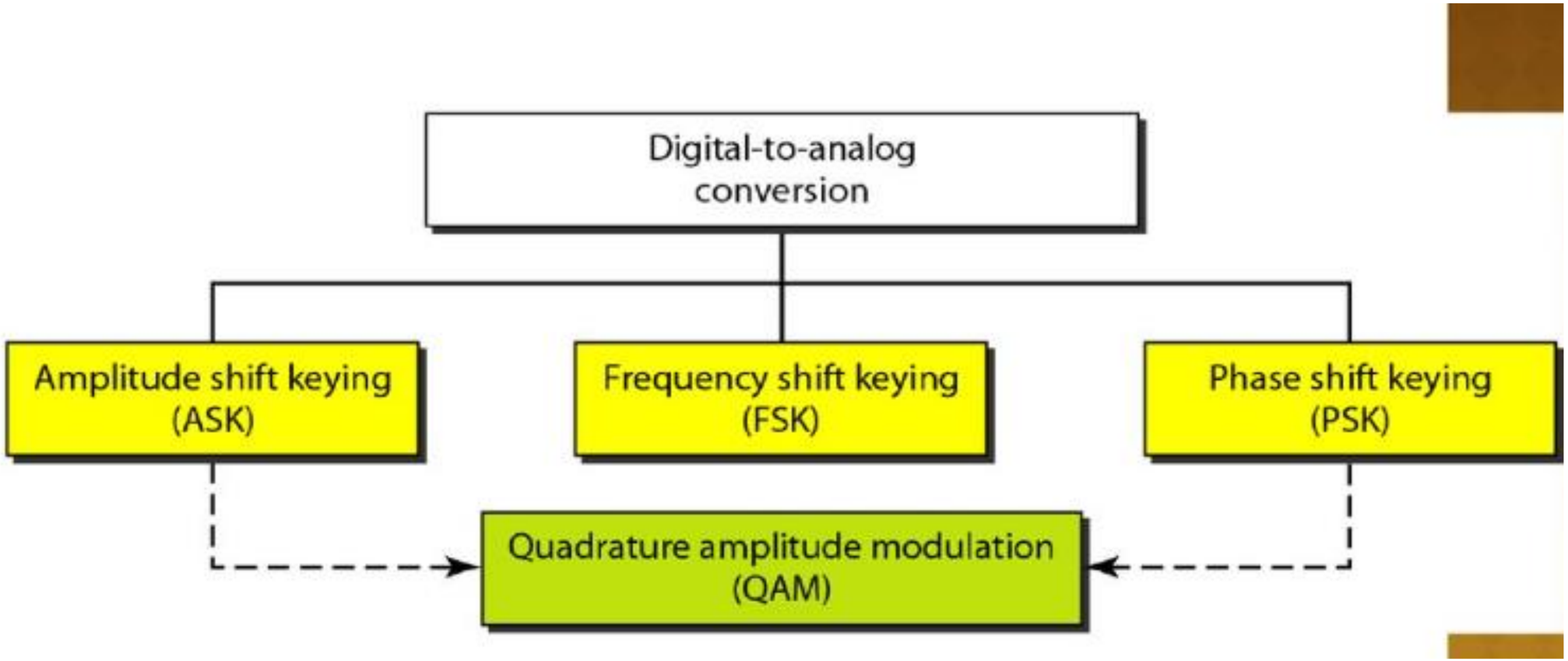
III YEAR/ V SEMESTER

UNIT 4 – DIGITAL MODULATION TECHNIQUES

TOPIC – **Amplitude Shift Keying (ASK)**

11/18/2023

OUTLINE


Digital-to-analog conversion
Amplitude shift keying (ASK)
Frequency shift keying (FSK)
Phase shift keying (PSK)
Quadrature amplitude modulation (QAM)

Amplitude Shift Keying / ON OFF Keying

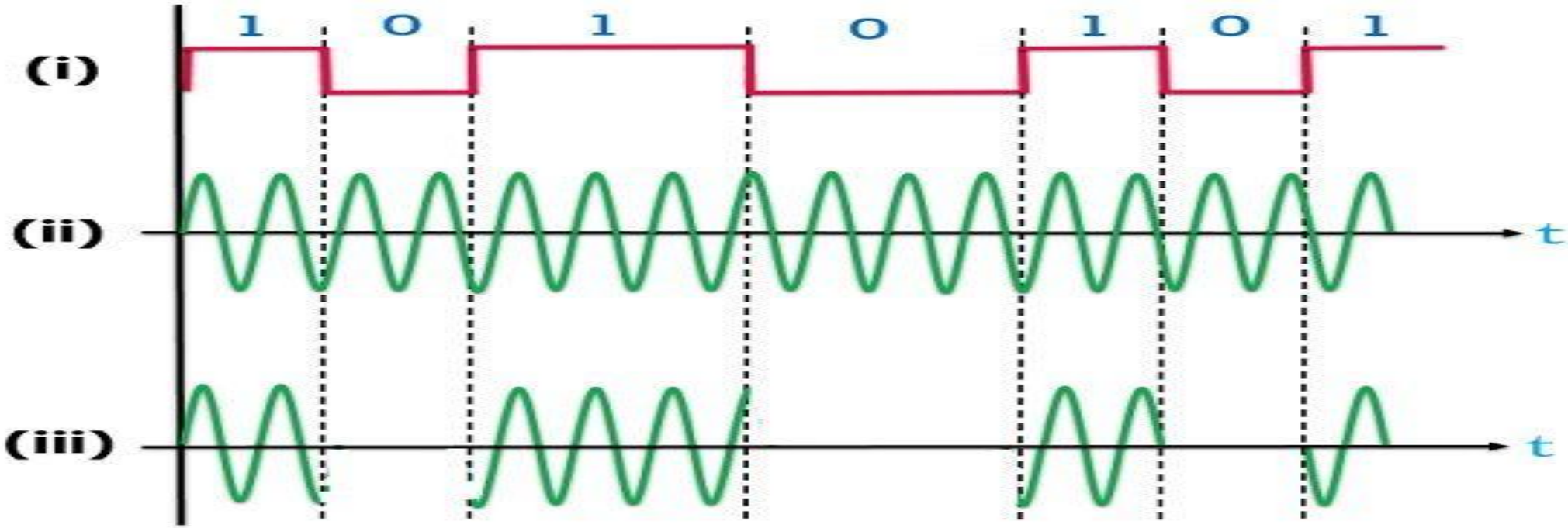
Amplitude Shift Keying (ASK) or ON-OFF Keying (OOK) is the simplest digital modulation technique. In this method, there is only one unit energy carrier and it is switched on or off depending upon the input binary sequence. The ASK waveform can be represented as,

$$s(t) = \sqrt{2P_s}\cos(2\pi f_0 t) \qquad \text{(To transmit '1')} \qquad \ldots (4.5.1)$$

To transmit symbol '0', the signal $s(t) = 0$. That is no signal is transmitted. $s(t)$ contains some complete cycles of carrier frequency 'f'. Thus,

symbol '1' $\Rightarrow$ pulse is transmitted, symbol '0' $\Rightarrow$ no pulse is transmitted.

Amplitude Shift Keying / ON OFF Keying



(i) = Digital bit sequence
(ii) = Carrier wave
(iii) = ASK modulated wave

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Thus the ASK waveform looks like an ON-OFF of the signal. Hence it is also called ON-OFF keying (OOK). Fig. 4.5.1 below shows the ASK waveform.

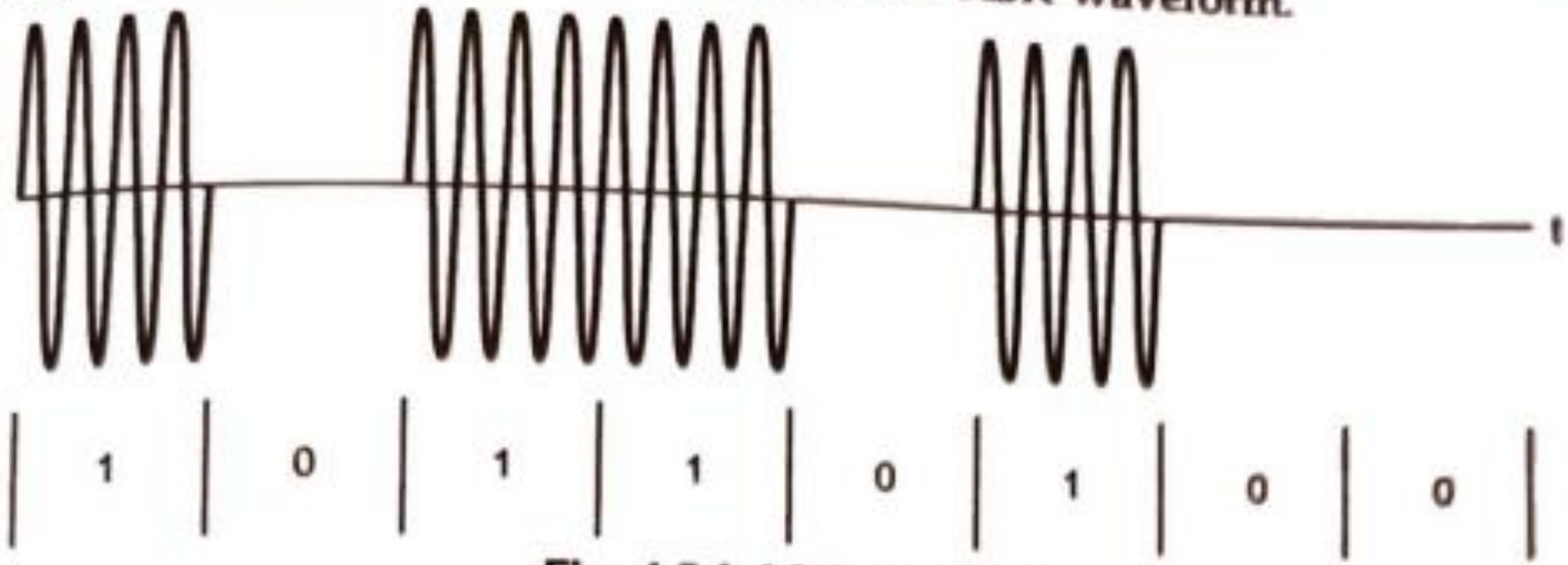


Fig. 4.5.1 ASK waveform

Fig. 4.5.1 ASK waveform

4.5.1 Signal Space Diagram of ASK

The ASK waveform of equation (4.5.1) for symbol '1' can be represented as,

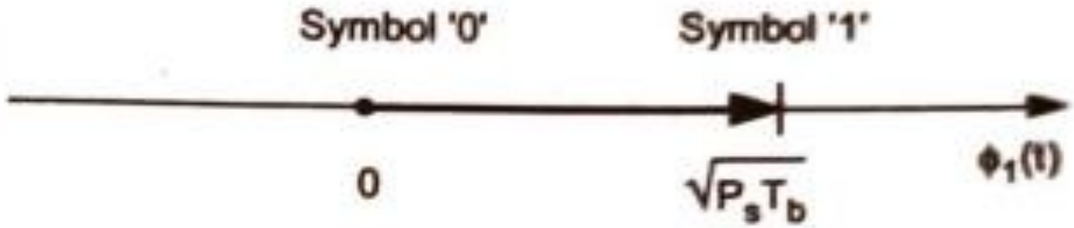


Fig. 4.5.2 Signal space diagram of ASK

$$s(t) = \sqrt{P_s T_b} \cdot \sqrt{2/T_b} \cos(2\pi f_0 t) = \sqrt{P_s T_b}\, \phi_1(t) \quad \ldots (4.5.2)$$

Thus there is only one carrier function $\phi_1(t)$. The signal space diagram will have two points on $\phi_1(t)$. One will be at zero and other will be at $\sqrt{P_s T_b}$. Fig. 4.5.2 shows this.

Therefore the distance between the two signal points will be,

$$d = \sqrt{P_s T_b} = \sqrt{E_b} \quad \ldots (4.5.3)$$

Amplitude Shift Keying -Generator

4.5.2 Generator and Coherent Detector of ASK

ASK Generator

Fig. 4.5.3 shows the ASK generator. The input binary sequence is applied to the product modulator. The product modulator amplitude modulates the sinusoidal carrier. It passes the carrier when input bit is '1'. It blocks the carrier (i.e. zero output) when intput bit is '0'. The wavefrom of ASK is as shown in Fig. 4.5.1.

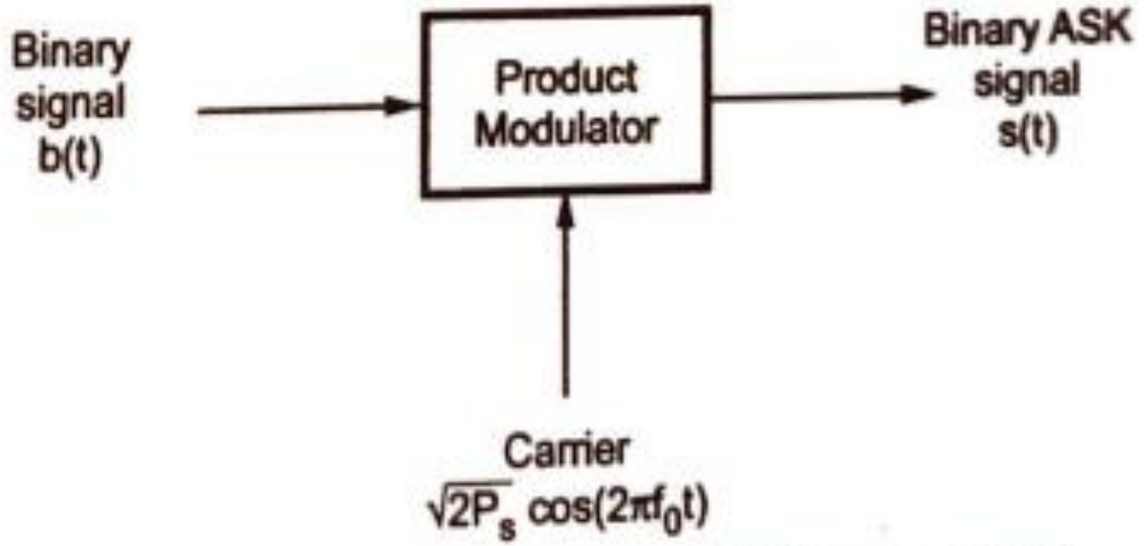
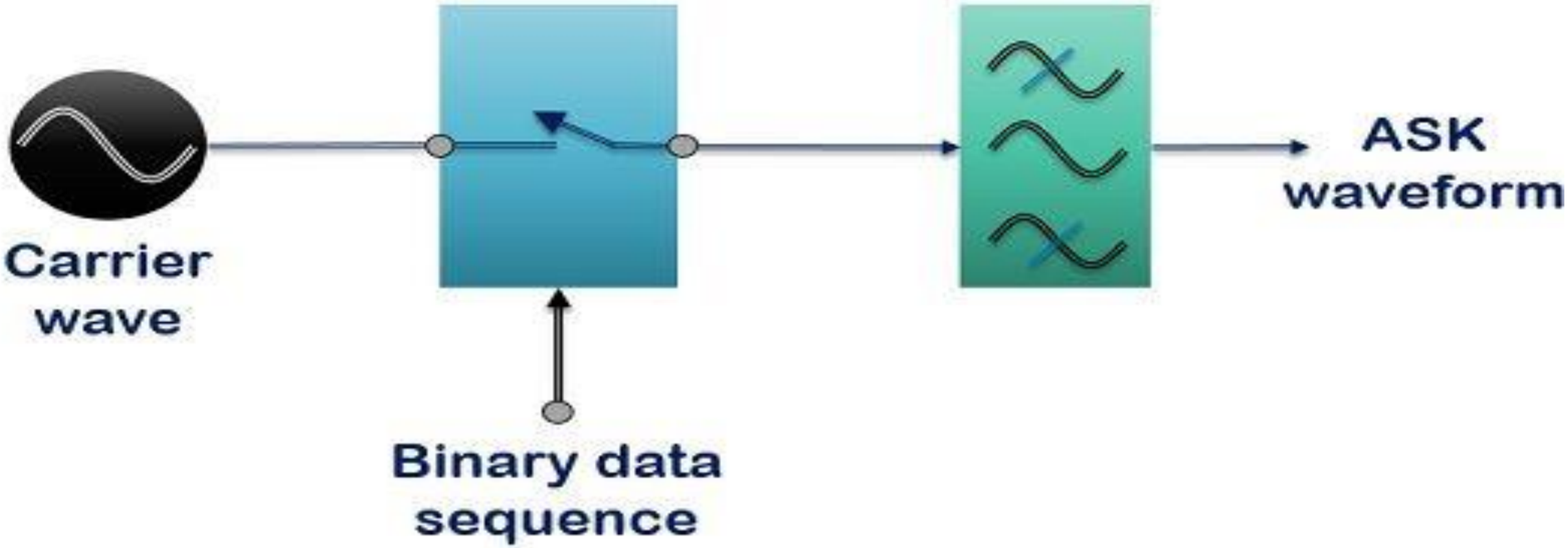


Fig. 4.5.3 Block diagram of ASK generator

Amplitude Shift Keying -Generator



Block diagram for generation of ASK waveform

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Amplitude Shift Keying -Generator

- It consists of a signal generator that produces a high-frequency sinusoidal waveform, a message signal in digitized form and a band pass filter.
- The switch provided here gets open and closed according to the bits of the message signal. When the digital bit is of level high i.e., 1 then the switch gets closed. Thus, allows the carrier wave to get transmitted.
- As against, in case of low-level bit i.e., 0 the switch gets open and restrict the carrier wave.
- This is the reason why the signal appears at the output in case of a high level. After this, pulse reshaping is done by the band limiting filter according to the amplitude and phase characteristics of the filter.

Amplitude Shift Keying –Detector

- Detection or demodulation is the process of recovering original message signal from the modulated waveform.

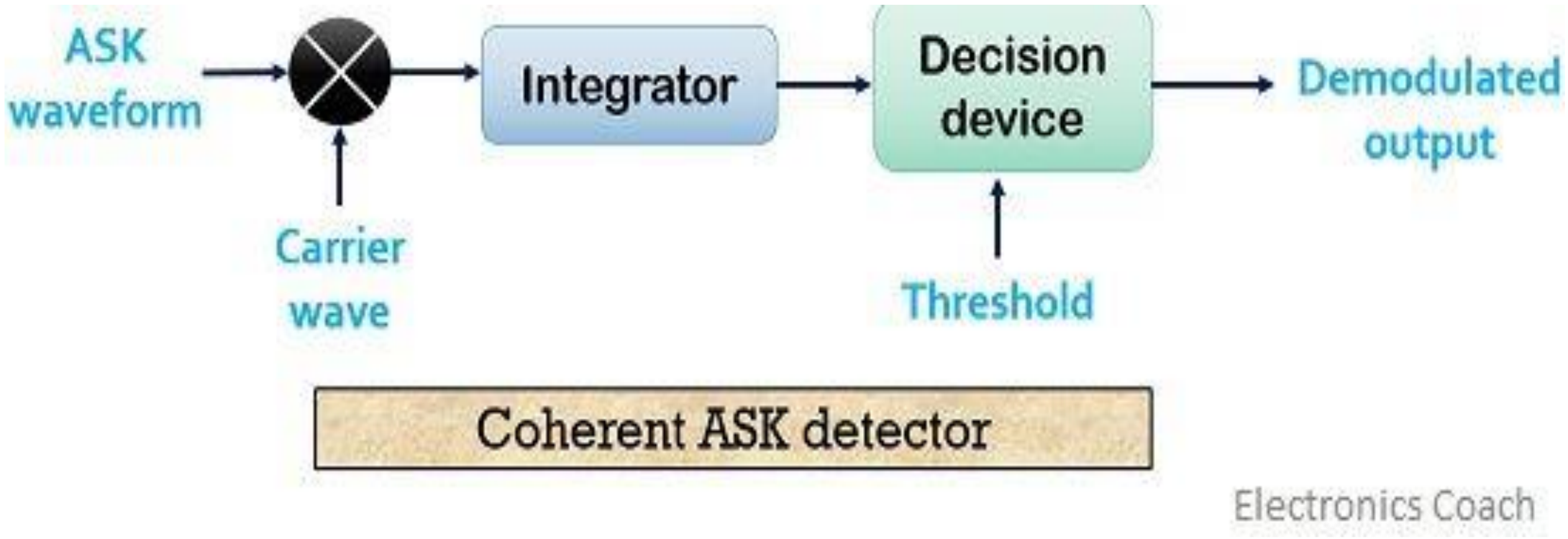
Coherent detection

- It is noteworthy in case of coherent detection that the carrier at the receiver must be in synchronization with the carrier at the transmitter for accurate detection.
- The demodulation circuitry consists of a product modulator along with an integrator and a decision-making device.
- Here, the input to the product modulator is modulated waveform along with the sinusoidal carrier. The combination of the two is then fed to the integrator that operates successively according to the bit interval. After which it also executes low pass filtration of the signal.

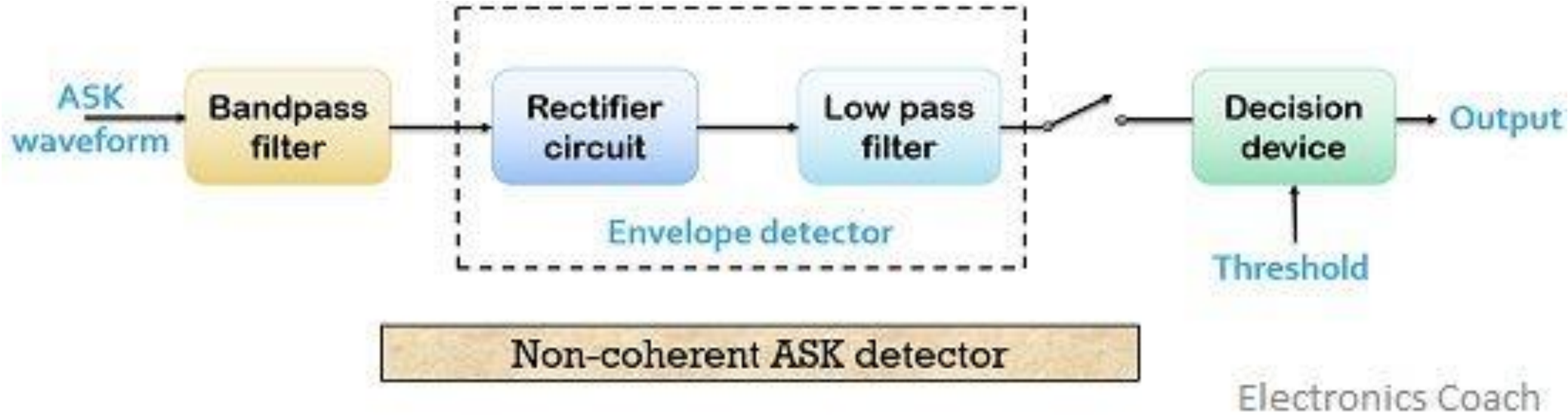
Amplitude Shift Keying –Detector

- Then the output of the integrator acts as input to the decision device. Also, a preset threshold is provided to the decision-making device. The decision device compares the signal at its input with the threshold value.
- When the signal exceeds the threshold value then bit 1 is provided by the decision device as its output. However, when the signal deceeds (be less than) the threshold value then bit 0 is achieved.

Amplitude Shift Keying –Detector



Amplitude Shift Keying –Non coherent Receiver



Amplitude Shift Keying –Power Spectral Density

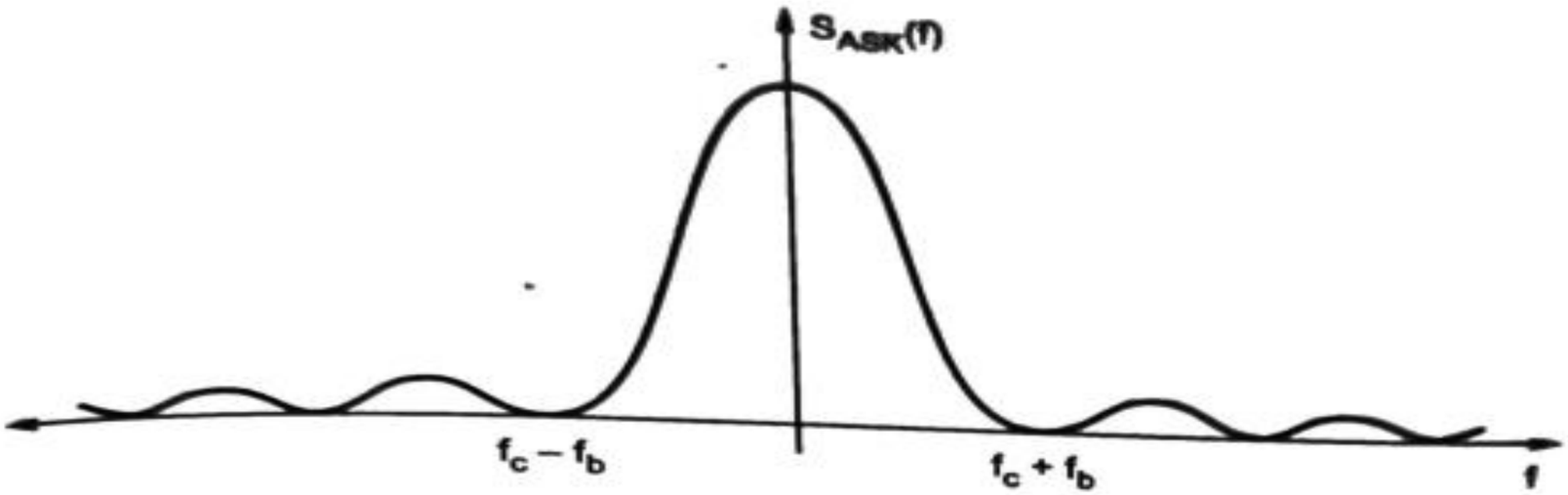


Fig. 4.5.6

Amplitude Shift Keying -Advantages

- It offers high bandwidth efficiency.
- It has a simple receiver design.
- Its generation and detection are easy thus facilitate a simple transmitter and receiver section.
- ASK modulation and demodulation are relatively low-cost methods.
- Its version OOK is used to relay morse codes over radio frequencies.
- Digital data can be transmitted over optical fiber using ASK modulation.

Disadvantages of ASK modulation

- It offers lower power efficiency.
- ASK modulation is very susceptible to noise interference. This is because noise has an impact on the amplitude.
- Poor bandwidth efficiency.
- ASK techniques are not suitable for high bit rate data transmission.

Applications of ASK modulation

- Digital data through an optical fiber is transmitted using ASK technique.
- The technique was widely used in traditional telephone modems.

THANK YOU