4.8.3 Advantages and Disadvantages of DPSK

DPSK has some advantages over BPSK, but at the same time it has some drawbacks.

Advantages:

1) DPSK does not need carrier at its receiver, Hence the complicated circuitry for generation of local carrier is avoided.

2) The bandwidth requirement of DPSK is reduced compared to that of BPSK.

Disadvantages:

1) The probability of error or bit error rate of DPSK is higher than that of BPSK.

2) Since DPSK uses two successive bits for its reception, error in the first bit creates error in the second bit. Hence error propagation in DPSK is more. Whereas in PSK single bit can go in error since detection of each bit is independent.

3) Noise interference in DPSK is more. In DPSK previous bit is used to detect next bit. Therefore if error is present in previous bit, detection of next can also go wrong. Thus error is created in next bit also. Thus there is tendency of appearing errors in pairs in DPSK.

2 MARKS

1. **Mention the need of optimum transmitting and receiving filter in baseband data transmission.**

When binary data is transmitted over the baseband channel, noise interferes with it. Because of this noise interference, errors are introduced in signal detection. Optimum filter performs two functions while receiving the noisy signal:

i) Optimum filter integrates the signal during the bit interval and checks the output at the time instant where signal to noise ratio is maximum.

ii) Transfer function of the optimum filter is selected so as to maximize signal to noise ratio.

iii) Optimum filter minimizes the probability of error.

2. **Define ASK.**

In ASK, carrier is switched on when binary '1' is to be transmitted and it is switched off when binary 'D' is to be transmitted ASK is also called on-off keying.

3. **What is meant by DPSK ?**

In DPSK, the input sequence is modified. Let input sequence be $d(t)$ and output sequence be $b(t)$. Sequence $b(t)$ changes level at the beginning of each interval in which $d(t) = 1$ and it does not changes level when $d(t) = 0$.

When $b(t)$ changes level, phase or the carrier is changed. And as stated above, $b(t)$ changes its level only when $d(t) = 1$. This means phase of the carrier is changed only if $d(t) = 1$. Hence the technique is called Differential PSK.

4. Explain coherent detection ?

In coherent detection, the local carrier generated at the receiver is phase locked with the carrier at the transmitter. The detection is done by correlating received noisy signal and locally generated carrier. The coherent detection is a synchronous detection.

5. What is the difference between PSK and FSK?

In PSK, *phase* of the carrier is switched according to input bit sequence. In FSK, *frequency* of the carrier is switch according to input bit sequence. FSK needs double of the bandwidth of PSK.

6. What is meant by coherent ASK?

In coherent ASK, correlation receiver is used to detect the signal. Locally generated carrier is correlated with incoming ASK Signal. The locally generated carrier is in exact phase with the transmitted carrier. Coherent ASK is also called synchronous ASK.

7. What is the major advantage of coherent PSK over coherent ASK?

ASK is on-off signaling, where as the modulated carrier is continuously transmitted in PSK. Hence peak power requirement is more in ASK, whereas it is reduced in case of PSK.

8. Explain the model of bandpass digital data transmission system ?

The bandpass digital data transmission system consists of source, encoder and modulator in the transmitter. Similarly receiver, decoder and destination forms the transmitter.

9. Which digital modulation technique gives better error probability ?

Binary PSK gives reduced error probability compared to ASK and FSK. It is given as

$$P_e = \frac{1}{2} erfc \sqrt{\frac{E}{N_0}}$$

10. In minimum shift keying what is the relation between the signal frequencies and bit rate?

Let the bit rate be $f_b b$ and frequency of carrier be f_o. Then higher and lower MSK signal frequencies are given as,

$$f_H = f_0 + \frac{f_b}{4}$$

$$f_L = f_0 - \frac{f_b}{4}$$

11. What do you understand by coherent detection?

Refer answer of Q.4.

12. Write the expression for bit error rate for coherent binary FSK.

The bit error rate of coherent binary FSK is given as,

$$P_e = \frac{1}{2} erfc \sqrt{\frac{0.6E}{N_0}}$$

13. Bring out the difference between coherent and noncoherent binary modulation schemes

Coherent Binary Modulation	Noncoherent Modulation
The local carrier generated is phase locked with the carrier at the transmitter	The receiver carrier need not be phase locked with transmitter. It is simple but it has higher probability of error
It is also called as synchronous detection	It is also called as envelope detection

14. What is the error probability of MSK and DPSK?

Error probability of MSK : $P_e = \frac{1}{2} erfc \sqrt{\frac{E_b}{N_0}}$

Error probability of DPSK : $P_e = \frac{1}{2} e^{-\frac{E_b}{N_0}}$

15. Highlight the major difference between a QPSK signal and a MSK signal.

MSK signal have continuous phase in all the cases, whereas QPSK signal has abrupt phase shift of $\frac{\pi}{2}$ *or* π. .

16. Compare the probability of error of PSK with that of FSK.

$$\text{BPSK} : p_e = \frac{1}{2} erfc \sqrt{\frac{E_b}{N_0}}$$

$$\text{BFSK} : P_e = \frac{1}{2} erfc \sqrt{\frac{0.6E_b}{4N_0}}$$

• For the fixed value of E_b/N_0, error probability of BPSK is less than BFSK

• For the given probability of error, the E_b/N_0 of BPSK is 3 dB less compared to that of BFSK.

17. Sate the difference between coherent and noncoherent binary modulation techniques.

Refer Q.13

18. Compare the probability of error of PSK with that of FSK.

Sr. No.	Error probability of PSK	Error probability of FSK
1.	$P_e = \frac{1}{2} erfc \sqrt{\frac{E}{N_0}}$	$P_e = \frac{1}{2} erfc \sqrt{\frac{0.6E}{N_0}}$
2.	For same $\frac{E}{N_0}$, error probability is less.	For same $\frac{E}{N_0}$, error probability is high.

19. Differentiate coherent and non coherent receivers.

Refer answer of Q.13.

20. What do you understand by continuous phase frequency shift keying?

CPFSK: In FSK, when the phase change is gradual at the bit transition times, the signal appears to be continuous in phase. This is called continuous phase FSK or CPFSK. To have phase continuity, the two FSK frequencies f_H *and* f_L must differ by a bit rate of f_b *or* $\frac{1}{T_b}$.

21. Draw the waveform for the binary data sequence 101100 modulated under a) FSK b) PSK.

Fig. shows the FSK and PSK waveforms.

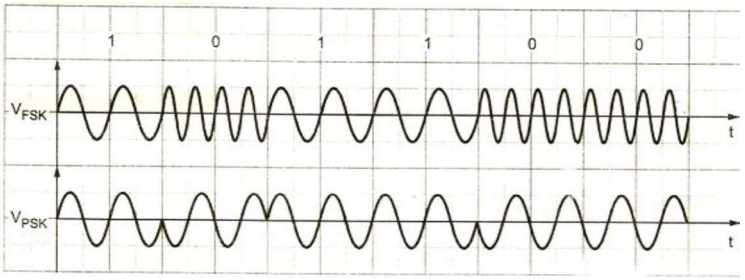

Fig. FSK and PSK waveforms

22. What are the advantages and disadvantages of differential phase shift keying?

Advantages:

1) DPSK does not need carrier at its receiver, Hence the complicated circuitry for generation of local carrier is avoided.

2) The bandwidth requirement of DPSK is reduced compared to that of BPSK.

Disadvantages:

1) The probability of error or bit error rate of DPSK is higher than that of BPSK.

2) Since DPSK uses two successive bits for its reception, error in the first bit creates error in the second bit. Hence error propagation in DPSK is more. Whereas in PSK single bit can go in error since detection of each bit is independent.

3) Noise interference in DPSK is more. In DPSK previous bit is used to detect next bit. Therefore if error is present in previous bit, detection of next can also go wrong. Thus error is created in next bit also. Thus there is tendency of appearing errors in pairs in DPSK.

23. Plot the power spectrum of a BPSK signal operated with a carrier frequency of 140 MHz, modulated by data bits at a rate of 2400 bits/sec. What is the bandwidth requirement?

Here $f_0 = 140\,MHz, f_b = 2400 bits/sec$

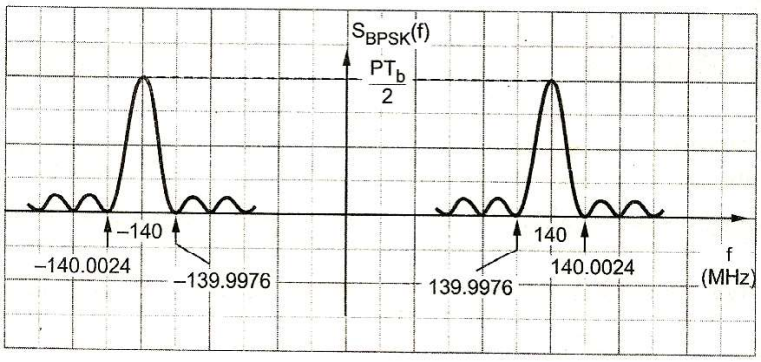

Fig. Power spectrum of BPSK

Bandwidth is given as,

$$BW = 2\,f_b$$

$$2\,x\,2400 = 4.8\,kHz$$

24. Give the signal space representation of QPSK. How is the performance of the system related to the distance between the symbols in the signal space ?

The error probability of the system is given as

$$P_e \leq \sum_{k=2}^{M} \frac{1}{2} erfc \sqrt{\frac{d_{k1}^2}{4N_0}}$$

Here 'M' are the number of signal points, d_{k1} is the distance between s_1 and s_k in the signal space

25. Compare: Coherent and non-coherent detection:

Refer answer of Q.13.

26. What is signal constellation diagram ?

The signal constellation diagram is similar to the phasor diagram but the entire phasor is not drawn. The signal constellation diagram shows only relative positions of the peaks of the phasors. The signal constellation diagram is also called **state space diagram**.

27. Draw the functional model of pass band data transmission.

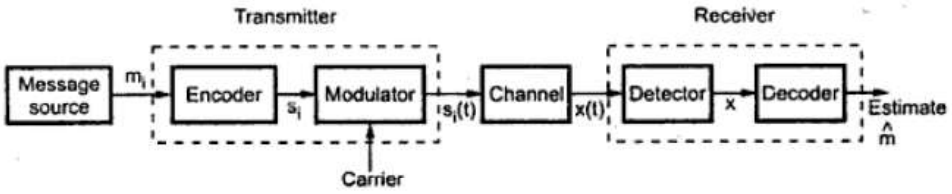

Fig. Model of passband data transmission system

28. Distinguish between coherent and noncoherent receivers.

Refer answer of Q.13.

29. Define QPSK.

• In QPSK two successive bits in the data sequence are grouped together. This combination of two bits forms four distinct symbols. When the symbol is changed to next symbol the phase of the carrier is changed by 45° $\left(\frac{\pi}{4}\right)$.

• Became of combination of two bits there will be four symbols. Hence the phase shift will be $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}$ or $\frac{7\pi}{4}$.

• QPSK reduces amplitude variations and required transmission bandwidth.

30. Differentiate baseband transmission from passband transmission.

Sr. No.	Baseband transmission	Passband transmission
1.	Signal is transmitted without any modulation of high frequency carrier.	The signal modulates high frequency carrier.
2.	Used for short distance transmission.	Used for long distance transmission.
3.	Used for LANs, printers, short distance links.	Used for transmission of digital video, data and speech.

31. Define MSK.

• MSK uses quadrature carriers which are orthogonal and difference between them is minimum.

• There are no abrupt changes in phase of MSK signal and it appears to be continuous.

32. Define QAM and draw its constellation diagram.

QAM : The phase as well as amplitude of the quadrature carriers is modulated. Hence it is called Quadrature Amplitude Phase shift keying or simply QAM.

33. A binary frequency shift keying system employs two signaling frequencies f_1 and f_2. The lower frequency f_1 is 1200 Hz and signaling rate is 500 baud. Calculate f_2.

For binary FSK,

$$\text{Baud} = f_b$$

$$f_b = 500 \text{ Hz}$$

Considering the FM modulation index *(h)* of '1' in FSK,

$$\frac{|f_m - f_s|}{f_b} = h = 1 \quad (Here \ \ h = 1)$$

$$|f_m - f_s| = f_b$$

$$since, \qquad f_s = f_1 = 1200\ Hz,$$

$$f_m - 1200Hz = 500Hz$$

$$f_m = 1700\ Hz$$

$$Thus, \qquad f_2 = f_m = 1700Hz$$

16 MARKS

1. What are the advantages and disadvantages of MSK as compared to QPSK system?(6)
2. Explain carrier synchronization in QPSK signal (6)