

Assignment 7

Digital Communication System-I

May 2023

Please answer the following questions:

Q 1: For a given SNR per bit, which of the following will have lowest bit error probability for orthogonal signalling with non-coherent detection?

- (a) $M = 4$
- (b) $M = 8$
- (c) $M = 16$
- (d) $M = 32$

Q 2: Choose the correct option

In the non-coherent case, the equivalent baseband model has a phase shift component $e^{j\phi}$ corresponding to the noise term.

- (a) True
- (b) False

Q 3: For a bit rate of 30 kbps, if the smallest transmitted frequency in a non-coherent binary MSK is 800 KHz, then the other transmitted frequency is

- (a) 830 KHz
- (b) 770 KHz
- (c) 740 KHz
- (d) 860 KHz

Q 4: Let $X \sim \mathcal{N}(1, 1)$ and $Y \sim \mathcal{N}(4, 1)$ be independent random variables, then $\sqrt{X^2 + Y^2}$ is distributed as

- (a) $\mathcal{N}(\sqrt{5}, 1)$
- (b) Rice($\sqrt{17}, 1$)
- (c) Rice(4, 1)
- (d) Rice($\sqrt{10}, 1$)

Q 5: For carrier modulated signals under AWGN channel, the random time asynchronism between the clocks of the transmitter and the receiver, t_d can cause large phase shifts

- (a) True
- (b) False

Q 6: Find out the probability of error for binary orthogonal FSK with noncoherent detection, if the SNR is 10 dB.

- (a) 2.27×10^{-5}
- (b) 3.4×10^{-3}

- (c) 6.7×10^{-3}
- (d) None of the above

Q 7: Which of the following statement is true?

- (a) For error probabilities less than 10^{-4} , the difference between the performance of coherent and noncoherent detection of binary orthogonal is less than 0.8 dB
- (b) The orthogonality under noncoherent detection guarantees orthogonality under coherent detection
- (c) For carrier modulated signals, an optimal noncoherent detector is an envelope detector.
- (d) All of the above

Q 8: For equal-probable and equal-energy carrier modulated signals with baseband equivalent received signal r_l over AWGN,

$$\langle s_{m,\ell}(t - t_d), \phi_{i,\ell}(t) \rangle \approx \langle s_{m,\ell}(t), \phi_{i,\ell}(t) \rangle$$

and ϕ uniform over $[0, 2\pi)$. The non coherent detection will be

- (a) $\hat{m} = \arg \max_{1 \leq m \leq M} \text{Re} [r_\ell s_{m,\ell}]$
- (b) $\hat{m} = \arg \max_{1 \leq m \leq M} |r_\ell s_{m,\ell}|$
- (c) $\hat{m} = \max_{1 \leq m \leq M} |r_\ell s_{m,\ell}|$
- (d) $\hat{m} = \arg \max_{1 \leq m \leq M} \text{Im} [r_\ell s_{m,\ell}]$

Q 9: If the transmitted binary data $c = 0 \ 0 \ 1 \ 0 \ 0 \ 1$, then find out the carrier phase at modulator output of DPSK system. Assume initial bit is zero.

- (a) $0 \ 0 \ \pi \ \pi \ \pi \ 0$
- (b) $\pi \ 0 \ 0 \ \pi \ 0 \ 0$
- (c) $\pi \ 0 \ 0 \ \pi \ 0 \ \pi$
- (d) $\pi \ \pi \ 0 \ \pi \ 0 \ \pi$

Q 10: Which of the following statement about DPSK is not true?

- (a) The information sequence determines the relative phase between adjacent symbol intervals
- (b) The information sequence determines the absolute phase at different symbol intervals
- (c) Phase ambiguity from a PLL will have no effect on the performance of DPSK system
- (d) None of these