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reviewer3@nptel.iitm.ac.in ▼

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## Unit 10 - Week 9

## Course outline

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- Lecture 44 : Principle of Invariance of Probability of Error
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## Assignment 9

The due date for submitting this assignment has passed.  
As per our records you have not submitted this assignment.

**Due on 2018-10-03, 23:59 IST.**

1) Consider the following set of quaternary signals defined in terms of orthogonal basis functions  $\varphi_1$  and  $\varphi_2$  : **1 point**

$$s_1 = 0; s_2 = \sqrt{2}a\varphi_1 - \sqrt{2}a\varphi_2; s_3 = 2\sqrt{2}a\varphi_1; s_4 = \sqrt{2}a\varphi_1 + \sqrt{2}a\varphi_2$$

Assuming that these signals are used for transmission of four equiprobable symbols over an AWGN channel with noise power spectral density  $\frac{N}{2}$ , the probability of symbol error is

$$P_e = Q\left(\sqrt{\frac{a^2}{N}}\right) - Q^2\left(\sqrt{\frac{a^2}{N}}\right)$$

$$P_e = Q\left(\sqrt{\frac{2a^2}{N}}\right) - 2Q^2\left(\sqrt{\frac{2a^2}{N}}\right)$$

$$P_e = 2Q\left(\sqrt{\frac{2a^2}{N}}\right) - Q^2\left(\sqrt{\frac{2a^2}{N}}\right)$$

$$P_e = 2Q\left(\sqrt{\frac{a^2}{N}}\right) - Q^2\left(\sqrt{\frac{a^2}{N}}\right)$$

**No, the answer is incorrect.**  
**Score: 0**

**Accepted Answers:**

$$P_e = 2Q\left(\sqrt{\frac{2a^2}{N}}\right) - Q^2\left(\sqrt{\frac{2a^2}{N}}\right)$$

2) The signal component of a coherent PSK system is defined **1 point**  
by  $s(t) = A_c k \sin(2\pi f_c t) \pm A_c \sqrt{1 - k^2} \cos(2\pi f_c t)$  where  $0 \leq t \leq T_b$ , and the plus sign corresponds to symbol 1 and the minus sign corresponds to symbol 0. The first term represents a carrier component included for the purpose of synchronizing the receiver to the transmitter. Then, in the presence of the additive white Gaussian noise of zero mean and power spectral density  $\frac{N}{2}$  and transmission of equiprobable symbols, the average probability of bit error  $P_b$  is

$$P_b = \frac{1}{2} Q\left(\sqrt{\frac{2A_c^2 T_b (1 - k^2)}{N}}\right)$$

$$P_b = Q\left(\sqrt{\frac{A_c^2 T_b (1 - k^2)}{N}}\right)$$

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$$P_b = \frac{1}{2} Q \left( \sqrt{\frac{A_c^2 T_b (1-k^2)}{N}} \right)$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$P_b = Q \left( \sqrt{\frac{A_c^2 T_b (1-k^2)}{N}} \right)$$

3) In Question-2, if 10% of the transmitted signal power is allocated to the carrier component, then bit energy-to-noise power spectral density ratio, i.e.,  $\frac{E_b}{N}$  required to obtain  $P_b = 10^{-4}$  is

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 7.50,7.90

1 point

4) Equiprobable binary data transmission over an AWGN channel with noise power spectral density  $\frac{N}{2} = 10^{-12} W/Hz$  is achieved at a bit rate  $R_b = 1Mbps$ . If the average probability of bit error  $P_b$  is not to exceed  $10^{-4}$  and there is a transmission loss of  $40dB$ , then the transmitted power in **watts** for coherent ASK is ...

Transmission loss is defined as:

$$T_{loss}(in\ dB) = 10\log_{10}(Average\ Transmitted\ Power) - 10\log_{10}(Average\ Received\ Power)$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 0.26,0.29

1 point

5) Equiprobable binary data is transmitted at the rate  $R_b = 1Mbps$  over an AWGN channel with noise power spectral density  $\frac{N}{2} = 10^{-10} W/Hz$ . For the average probability of bit error  $P_b$  not to exceed  $10^{-4}$ , the required average transmitted carrier power in **milliwatts** for a communication link that uses coherent BFSK is ...

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 2.60,2.90

1 point

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