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Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Digital Communication

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Derive the expression for error probability of binary phase shift keying using coherent detection. **(08 Marks)**

   b. An FSK system transmits binary data at the rate of 2×10^6 bit per sec. During the source of transmission, AWGN of zero mean and two sided power spectral density 10^{-20} W/Hz is added to the signal. The amplitude of received wave for digit 1 or 0 is 1 microvolt. Determine the average probability of symbol error assuming non-coherent detection. **(06 Marks)**

   c. Explain the concept of M-ary PSK. **(06 Marks)**

OR

2 a. With a neat block diagram, explain non-coherent detection of binary FSK technique. **(08 Marks)**

   b. Binary data is transmitted over AWGN channel using BPSK at a rate of 1Mbps. It is desired to have average probability of error $p_e \leq 10^{-4}$. Noise PSD = 10^{-12} W/Hz. Determine the average carrier power required at receiver input if the detector is of coherent type. [Assume erfc (3.5) = 0.00025]. **(06 Marks)**

   c. Explain the generation and detection of DPSK with neat block diagram. **(06 Marks)**

Module-2

3 a. Explain the geometric representation of set of in energy signals as combination of N orthonormal basis function. Illustrate the case of N = 2 and M = 3 with necessary diagrams and expressions. **(08 Marks)**

   b. Explain the correlation receiver using coherent detection. **(06 Marks)**

   c. Explain the design of band limited signals with controller ISI-partial response signal. **(06 Marks)**

OR

4 a. Using Gram-Schmidt orthogonalization procedure find the set of orthonormal basis function to represent the signals $s_1(t)$, $s_2(t)$ and $s_3(t)$ as shown in Fig.Q.4(a). Also express each of these signals interms of set of basis function.
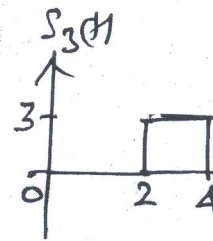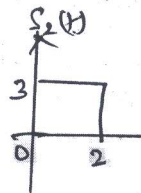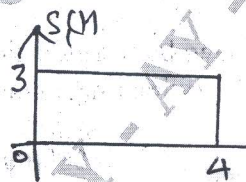

Fig.Q.4(a)

(10 Marks)

   b. State and prove Nyquist condition for zero ISI. **(10 Marks)**

Module-3

5 a. Explain the model of spread spectrum digital communication system. **(10 Marks)**

   b. With a neat block diagram, explain the CDMA system band on IS-95. **(10 Marks)**

OR

6 a. Explain the frequency hopped spread spectrum technique with neat transmitter and receiver block diagram. **(08 Marks)**

   b. The SNR required at the detector to achieve reliable communication in a DSSS communication system is 13dB. If the interference to signal power at the receiver is 20dB. Determine the processing gain required. **(04 Marks)**

   c. Write a note on application of DS spread spectrum systems. **(08 Marks)**

Module-4

7 a. Define the following with respect to information theory :
   i) Self information
   ii) Entropy
   iii) Source efficiency
   iv) Rate of information. **(08 Marks)**

   b. Construct binary code for the following source using Shannon's binary encoding procedure. $s = \{s_1, s_2, s_3, s_4, s_5\}$ $p = \{0.4, 0.25, 0.15, 0.12, 0.08\}$. **(08 Marks)**

   c. Explain the types of methods of controlling error. **(04 Marks)**

OR

8 a. Six messages symbols with probability of 0.4, 0.2, 0.2, 0.1, 0.07, 0.03, construct a binary code by using Shannon's Fano encoding procedure. Also determine code efficiency and redundancy. **(10 Marks)**

   b. A source produces 5 symbols with probabilities of 0.1, 0.3, 0.4, 0.12 and 0.08.
   i) Construct a binary Huffman code
   ii) Determine efficiency and redundancy of the code
   iii) Draw code-tree. **(10 Marks)**

Module-5

9 a. A (7, 4) linear block code having partly matrix $P = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$

   i) Find all possible code vector
   ii) Draw the encoding circuit
   iii) Draw the syndrome circuit. **(10 Marks)**

   b. A (3, 1, 2) convolutional code with $g^{(1)} = (110)$, $g^{(2)} = (101)$ and $g^{(3)} = (111)$.
   i) Draw the encoder block diagram.
   ii) Find the generator matrix.
   iii) Find the code word for information sequence (11101) using transform domain approach. **(10 Marks)**

OR

10 a. For a (2, 1, 4) convolutional encoder as shown in Fig.Q.10(a). **(10 Marks)**

Fig.Q.10(a)

Find the codeward corresponding to the information source (10111). Using time domain and transform domain approach. **(10 Marks)**

b. A, (2, 1, 2) binary convolutional encoder as shown in Fig.Q.10(b). Draw the state table, state transition table, state diagram and corresponding code tree, for the message 10111. Find the encoded sequence.

Fig.Q.10(b)

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