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21EC51

Fifth Semester B.E. Degree Examination, June/July 2024
Digital Communication

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. With a neat block diagram, explain the generation and detection of coherent QPSK signal. **(10 Marks)**

b. Binary data is transmitted over a microwave link at a rate of 10^6 bits/sec and the PSD of noise at the receiver input is 10^{-10} watt/Hz. Find the average carrier power required to maintain an average probability of error $P_C \leq 10^{-4}$ for coherent binary FSK. What is the required channel bandwidth? Assume $\text{erf}(2.8) = 0.9998$. **(10 Marks)**

OR

2 a. With a neat block diagram, explain the generation and detection of non-coherent DPSK signal. **(10 Marks)**

b. Derive an expression for error probability of binary PSK using coherent detection. **(10 Marks)**

Module-2

3 a. Explain error-Schmidt orthogonalization procedure. **(10 Marks)**

b. Explain matched filter receiver. List the properties of matched filter receiver. **(10 Marks)**

OR

4 a. Three signals $S_1(f)$, $S_2(f)$ and $S_3(f)$ are shown in Fig. Q4 (a) below. Apply Gram-Schmidt procedure to obtain an orthonormal basis for signals. Express $S_1(f)$, $S_2(f)$ and $S_3(f)$ in terms of orthonormal basis functions. **(10 Marks)**

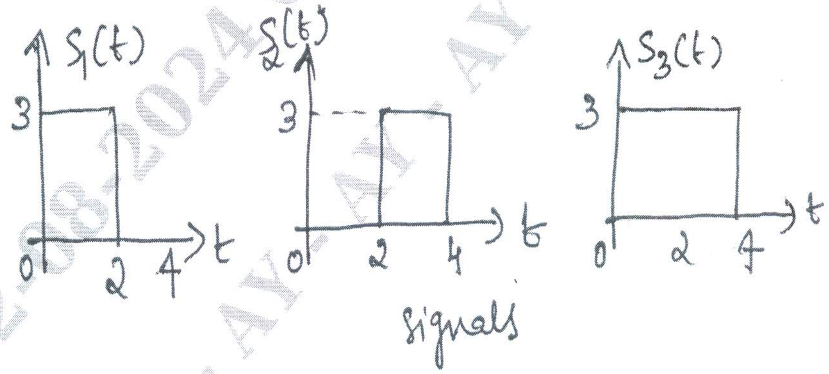

Fig. Q4 (a)

b. Explain the design of bandlimited signals, with controlled ISI-partial response. **(10 Marks)**

Module-3

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

b. Explain direct sequence spread-spectrum system. **(10 Marks)**

OR

6 a. For a linear feedback shift register with three stage (M = 3), evaluate the maximum length PN sequence for feedback taps = (3, 1). Draw the schematic arrangement and verify all the properties of PN sequence is generated output. Sketch the sequence, its autocorrelation function. If the chip rate happens to be 10 MHz.
Test all the three properties of ML sequence after generating PN sequence for a 3-stage feedback shift register. Assume 100 as initial state. **(10 Marks)**

b. Explain the application of DS-spread spectrum signals. **(10 Marks)**

Module-4

7 a. State the properties of entropy. Derive an expression for average information content of symbols in long independent sequences. **(10 Marks)**

b. A source emits an independent sequence of symbols from an alphabet consisting of five symbols. A, B, C, D and E with probabilities of $\frac{1}{4}, \frac{1}{8}, \frac{1}{8}, \frac{3}{16}$ and $\frac{5}{16}$ respectively. Find the Shannon binary code for each symbol and efficiency of the coding scheme. **(10 Marks)**

OR

8 a. Consider the zero memory source with probabilities $P = \{0.4, 0.2, 0.1, 0.1, 0.05, 0.05\}$
(i) Construct a binary Huffman code by placing the composite symbol as low as possible.
(ii) Construct binary Huffman code by placing composite symbol as high as possible. In each case compute the variances of the word length and comment on the result. **(10 Marks)**

b. Explain the types of codes. **(10 Marks)**

Module-5

9 a. Define Hamming weight, Hamming distance and Minimum distance. **(06 Marks)**

b. Explain single error correcting Hamming codes. **(06 Marks)**

c. What do you understand by Trelli's diagram? Explain clearly. **(08 Marks)**

OR

10 a. Explain Matrix description of Linear block codes. **(10 Marks)**

b. For a systematic (7, 4) LBC, the parity matrix P is given by $P = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$.
(i) Find all possible valid code-vectors.
(ii) Draw the corresponding encoding circuit.
(iii) A single error has occurred within the given received vectors. Detect and correct those errors, $R_A = 0111110$ and $R_B = 1011100$
(iv) Draw the syndrome calculation circuit. **(10 Marks)**

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