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18EC61

Sixth Semester B.E. Degree Examination, July/August 2022 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. What are the applications of Hilbert transform? Prove that a signal $g(t)$ and its Hilbert transform $\hat{g}(t)$ are orthogonal over the entire time interval $(-\infty, \infty)$. (08 Marks)
- b. For a binary sequence 0 1 0 0 0 0 0 1 0 1 1 construct :
 i) RZ Bipolar format ii) Manchester format iii) B3ZS format iv) B6ZS format
 v) HDB3 format. (08 Marks)
- c. Define Pre-envelope of a real valued signal. Given a band pass signal $S(t)$, sketch the amplitude spectra of signal $S(t)$, Pre-envelope $S_+(t)$ and Complex envelope $\tilde{S}(t)$. (04 Marks)

OR

- 2 a. Express Bandpass signal $S(t)$ in canonical form. Also explain the scheme for deriving the in-phase and quadrature components of the band pass signal $S(t)$. (08 Marks)
- b. Derive the expression for the complex low pass representation of band pass systems. (08 Marks)
- c. Write a note on HDBN signaling. (04 Marks)

Module-2

- 3 a. Explain the geometric representation of set of M energy signals as linear combination of N orthonormal basis functions. Illustrate for the case $N = 2$ and $M = 3$ with necessary diagrams and expressions. (10 Marks)
- b. Explain the Correlation receiver using product integrator and matched filter. (10 Marks)

OR

- 4 a. Using the Gram – Schmidt Orthogonalization procedure, find a set of orthonormal basis functions to represent the three signals $S_1(t)$, $S_2(t)$ and $S_3(t)$ shown in Fig. Q4(a). Also express each of these signals in terms of the set of basis functions. (12 Marks)

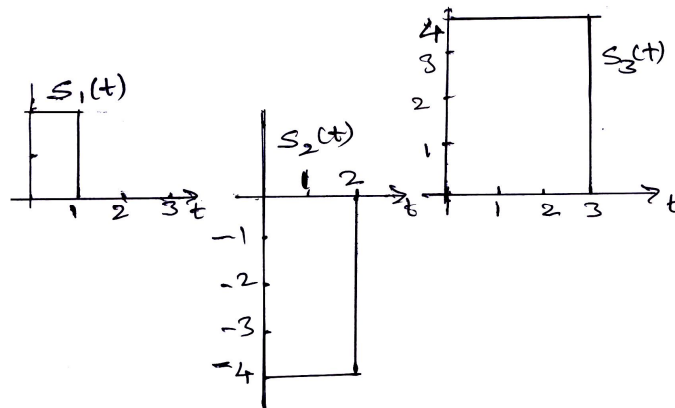


Fig. Q4(a)

- b. Show that for a noisy input, the mean value of the j^{th} correlator output X_j depends only on S_{ij} and all the correlator outputs X_j , $j = 1, 2, \dots, N$ have a variance equal to the PSD $N_{0/2}$ of the additive noise process $W(t)$. (08 Marks)

Module-3

- 5 a. Derive the expression for error probability of binary PSK using coherent detection. (06 Marks)
- b. Explain the generation and optimum detection of differential phase – shift keying, with neat block diagram. (08 Marks)
- c. A binary data is transmitted over a microwave link at a rate of 10^6 bits/sec and the PSD of noise at the receiver is 10^{-10} watts/Hz. Find the average carrier power required to maintain an average probability of error $P_e \leq 10^{-4}$ for coherent binary FSK. What is the required channel bandwidth? (Given $\text{erf}(2.6) = 0.9998$). (06 Marks)

OR

- 6 a. With a neat block diagram, explain the non – coherent detection of binary frequency shift keying technique. (08 Marks)
- b. In a FSK system, following data are observed. Transmitted binary data rate = 2.5×10^6 bits/second PSD of zero mean AWGN = 10^{-20} Watts/Hz. Amplitude of received signal in the absence of noise = $1\mu\text{V}$. Determine the average probability of symbol error assuming coherent detection. (Given $\text{erf}(2.5) = 0.99959$). (08 Marks)
- c. What is the advantage of M – ary QAM over M – ary PSK system? Obtain the constellation of QAM for $M = 4$ and draw signal space diagram. (04 Marks)

Module-4

- 7 a. With a neat block diagram, explain the digital PAM technique through band limited base band channels. Also obtain the expression for inter symbol interference. (08 Marks)
- b. State and prove Nyquist condition for zero ISI. (08 Marks)
- c. With neat diagram and relevant expression, explain the concept of adaptive equalization. (04 Marks)

OR

- 8 a. For a binary data sequence $\{d_n\}$ given by 1 1 1 0 1 0 0 1. Determine the precoded sequence, transmitted sequence, received sequence and the decoded sequence. (06 Marks)
- b. Draw and explain the time – domain and frequency domain of duo – binary and modified duo binary signal. (08 Marks)
- c. With neat diagram, explain the timing features pertaining to eye diagram and its interpretation for base band binary data transmission system. (06 Marks)

Module-5

- 9 a. Explain the model of a Spread Spectrum digital Communication system. (08 Marks)
- b. Explain the effect of despreading on a narrow band interference in Direct Sequence Spread Spectrum System (DSSS). A DSSS signal is designed to have the power ratio $\frac{P_R}{P_N}$ at the intended receiver is 10^{-2} . If the desired $\frac{E_b}{N_0} = 10$ for acceptable performance determine the minimum value of processing gain. (08 Marks)
- c. What is a PN sequence? Explain the generation of maximum length (ML – Sequence). What are the properties of ML sequences? (04 Marks)

OR

- 10 a. With a neat block diagram, explain frequency Hopped Spread Spectrum Technique. Explain the terms Chip rate, Jamming Margin and Processing gain. (10 Marks)
- b. With a neat block diagram, explain the CDMA System based on IS - 95. (10 Marks)