BITS, PILANI-DUBAI
Dubai International Academic City

Fourth-Year EEE, I Semester, 2007-2008
Test – 1 (Closed Book)
Course No. / Course Name: EEE UC416 / Digital Communication
Date: 11 Nov 2007 Duration: 50 min Marks: 50 Weightage: 25%

Note:- *Answer all questions*

1. Discuss the role of the digital modulator and demodulator in an *M*-ary digital communication system. (6 marks)
2. Discuss the appropriate channel model used for wireline telephone channels. (8 marks)
3. Explain the various steps involved in the Gram-Schmidt orthogonalization procedure. (8 marks)
4. Show that for a binomial random variable, the mean is given by *np* and the variance is given by *np*(*1-p*). (8 marks)
5. Draw the *M*=8 signal-point contellations in two dimensions for biorthogonal signal waveforms with different energies. (8 marks)
6. Binary antipodal signals are used to transmit information over an AWGN channel. The prior probabilities for the two input symbols (bits) are 1/3 and 2/3. Determine the average probability of error as a function of E_b/N_o. (12 marks)

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Fourth-Year EEE, I Semester, 2007-2008
Test – 2 (Open Book)
Course No. / Course Name: EEE UC416 / Digital Communication
Date: 16 Dec 2007 Duration: 50 min Marks: 40 Weightage: 20%

Note:- *Answer all questions*

1. What is the resulting SQNR in dB for a signal uniformly distributed on [1,-1] when uniform PCM with 128 levels is employed? Derive the formula used. (10 marks)

2. Sketch the PSK waveform for the binary sequence 01001101110010. Using this sequence explain the working of a DPSK modulator and demodulator. You may make suitable assumptions. (10 marks)

3. Explain the Lempel-Ziv algorithm using the binary sequence given in Problem 2 above. (10 marks)

4. Consider a Gaussian random variable with zero mean and variance equal to 10^{-8}. What is the probability that the value of the random variable exceeds 2×10^{-4}? You may express the answer in tems of the Q-function. (10 marks)

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Fourth-Year EEE, I Semester, 2007-2008
Comprehensive Examination (Closed Book)
Course No. / Course Name: EEE UC416 / Digital Communication
Date: 03 Jan 2008 Duration: 3 hours Marks: 80 Weightage: 40%

Note:- *Answer all questions*

1. (a) Define autocorrelation $R_{XX}(\tau)$ of a random process $X(t)$. (b) When is a random process said to be wide-sense stationary? (c) Explain the notions of time averages, ensemble averages, and ergodicity. (2+2+6)

2. Consider the signals $s_1(t), s_2(t), s_3(t)$, and $s_4(t)$ as detailed below. Using Gram-Schmidt orthogonalization procedure, find an orthonormal basis for this set of signals.
$s_1(t)=\begin{cases}1, 0\le t\le T/3\\ 0, \textit{otherwise}\end{cases}$, $s_2(t)=\begin{cases}1, 0\le t\le 2T/3\\ 0, \textit{otherwise}\end{cases}$, $s_3(t)=\begin{cases}1, T/3\le t\le T\\ 0, \textit{otherwise}\end{cases}$, and
$s_4(t)=\begin{cases}1, 0\le t\le T\\ 0, \textit{otherwise}\end{cases}$. (10)

3. A source has an alphabet m_1, m_2, m_3, and m_4 with corresponding probabilities {0.1, 0.2, 0.3, 0.4}. (a) Find the entropy of the source. (b) What is the minimum required average code word length to represent this source for error-free reconstruction? (c) Design a Huffman code for the source. (3+2+5)

4. Determine the average energy of a set of M PAM signals of the form $s_m(t)=s_m\psi(t), m=1,2,...,M, 0\le t\le T$ where $s_m=\sqrt{E_g}A_m$. The signals are equiprobable with amplitudes that are symmetric about zero and are uniformly spaced with distance d between adjacent amplitudes. (10)

5. A PCM system uses a uniform quantizer followed by a 7-bit binary encoder. The bit rate of the system is equal to 50×10^6 bits per second. (a) What is the maximum message bandwidth for which the system operates satisfactorily? (b) Determine the output signal-to-quantizing noise ratio when a full-load sinusoidal modulating wave of frequency 1 MHz is applied. (5+5)

6. What is meant by symbol synchronization? Write a brief note on the early-late gate synchronizer. (3+6)

7. Derive and plot the power spectrum of a discrete PAM signal in the NRZ bipolar format. What do you infer from the plot? (8+2)

8. Write short notes on (a) Trellis coding with an example, (b) Ordinary FSK versus continuous-phase FSK, (c) Direct-sequence spread spectrum systems. (4+3+4)