BITS, Pilani-Dubai
Dubai International Academic City

Fourth Year EEE, I Semester, 2008-2009
Comprehensive Examination
Course No. and Title: EEE UC416 Digital Communication (Elective)

09 Oct 2008 Duration: 50 min Max Marks: 50 Weightage: 25%

Answer all questions

1. Discuss briefly with a block diagram the basic elements of a digital communication system. (5)
2. Explain the working of DPCM with the help of neat block diagrams. (8)
3. What are the best choice values of a_1 and a_2 in a 2-tap predictor when the input has a correlation function given by $R_x(0)=1, R_x(1)=R_x(-1)=0.5, R_x(2)=0.25$? (6)
4. Under what conditions can two disjoint events A and B be independent? Justify (5)
5. Explain the concept of *channel capacity*. For a channel operating in the presence of additive white Gaussian noise (AWGN), what happens to the channel capacity as bandwidth tends to infinity?
   Obtain the channel capacity of an AWGN channel with a bandwidth of 1 MHz and an S/N ratio of 40 dB. (4 + 2 + 4)
6. A TV picture contains 211,000 picture elements. Suppose that this can be considered a digital signal with eight brightness levels for each element. Assume that each brightness level is equally probable. (a) What is the information content of a picture? (b) What is the information transmission rate (bits per second) if 30 separate pictures (frames) are transmitted per second? (5 + 3)
7. An audio signal of the form $m(t)=3\cos 1000\pi t$ is quantized using delta modulation. Find the signal-to-quantization noise ratio (after deriving the formula used). Assume that the sampling frequency is eight times the Nyquist rate. (8)

BITS, PILANI-DUBAI
Dubai International Academic City
Fourth-Year EEE, I Semester, 2008-2009
Test – 2 (Open Book)
Course No. / Course Name: EEE C416 / Digital Communication
Date: 09 Nov 2008 Duration: 50 min Max. Marks: 20 Weightage: 20%

Note:-
Answer all questions. All questions carry equal marks.
Assumptions made, if any, should be clearly indicated.
A table of the Q-function is provided.

1. A Gaussian random variable has a mean value of 2. The probability that the variable lies between 2 and 5 is 0.3. Find the probability that the variable is between 1 and 3. What is the variance of the random variable?

2. Consider the experiment of starting a sinusoidal generator of deterministic frequency f_0 and amplitude A. The exact starting time is random. Thus, $x(t) = A\sin(2\pi f_0 t + \theta)$ where the phase θ is a random variable with uniform density over the interval $[0, 2\pi]$. Find the autocorrelation of the random process.

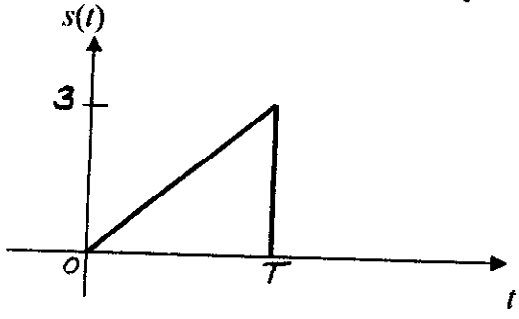
3. If we transmit five-bit words and the probability of a bit error is 10^{-4}, find the probability of a single bit error in a five-bit word. Also find the probability of two bit errors. What do you infer from the two answers?

4. You are given a (n, k) code with the following parity check matrix:

$$\begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 & 1 & 1 \end{bmatrix}$$

   (a) What are the values of n and k?
   (b) Find the minimum distance between code words.
   (c) Is this a Hamming code? (d) You receive the word (0000011). What is the correct data (information) word?

5. Find the output SNR of a matched filter, where the signal is as shown in figure below. The noise is white with power spectral density $\eta/2$.



BITS, Pilani-Dubai
Dubai International Academic City

BE (Hons.) EEE, IV Year, First Semester, 2008-09
Surprise Quiz #

Course Title: Digital Communication (Elective) Course No.: EEE C 416
Marks: 10 Weightage: 5% Duration: 20 minutes

Name: _____

ID No.: _____

Answer all questions:

1. A signal $m(t) = \cos 200\pi t + 2\cos 320\pi t$ is ideally sampled at $f_s = 300$ Hz. If the sampled signal is passed through an ideal low-pass filter with cutoff frequency of 250 Hz, what frequency components will appear in the output? (6 marks)

2. What is the average information content in the English language, assuming that each of the characters in the alphabet occurs with equal probability? (4 marks)

BITS, Pilani-Dubai
Dubai International Academic City

BE (Hons.) EEE, IV Year, First Semester, 2008-09
Surprise Quiz # 2

Course Title: Digital Communication (Elective) Course No.: EEE C 416
Marks: 10 Weightage: 5% Duration: 20 minutes

Name: _____

ID No.: _____

For the convolutional encoder shown below:

1. Find the impulse response.
2. Find the output code word if the input sequence is all 1's.

BITS, PILANI-DUBAI
Dubai International Academic City, Dubai

B.E. (Hons.) EEE Fourth Year, I Semester 2008-2009
Comprehensive Examination

Course Name: Digital Communication (Elective) Course No.: EEE C416
Duration: 3 hours Max. Marks: 40 Weightage: 40 %

Note:- *Answer all questions. Appropriate assumptions may be made, where necessary. This question paper has* ***two pages.***

1) Consider a WSS stochastic process $x(t)$ with mean value m and autocorrelation $R_x(\tau)$. Find the mean and autocorrelation of the process $y(t) = x(t) - x(t-T)$. (4)

2) Which of the following could *not* be the autocorrelation function of a process and **why** (only a precise answer will be accepted)? (a) $R_a(\tau) = \begin{cases} 1-|\tau|, & |\tau| < 1 \\ 0, & |\tau| > 1 \end{cases}$ (b) $R_b(\tau) = 5\sin 3\tau$ (c) $R_c(\tau) = \begin{cases} 1 & |\tau| < 2 \\ 0, & |\tau| > 2 \end{cases}$ (d) $R_d(\tau) = \dfrac{\sin \tau}{\tau}$ (2)

3) An eight-bit word is formed from four information bits and four parity bits, with the parity bits given by the following equations:

$c_1 = u_2 + u_3 + u_4$

$c_2 = u_1 + u_2 + u_3$

$c_3 = u_1 + u_2 + u_4$

$c_4 = u_1 + u_3 + u_4$

(a) Find the generating matrix [G]. (b) Demonstrate the decoding process for any single message without as well as with a single bit error. (c) Draw a circuit using shift register that generates the syndrome for this code. (1+2+2)

4) A binary signal $s_i(t)$ is transmitted as either a +1-volt or -1-volt pulse during the interval (0, T). The signal gets corrupted by additive white noise with power spectral density $\eta/2 = 10^{-5}$ W/Hz. Find the maximum bit rate that can be sent with a bit error probability of $P_e \leq 5\times10^{-4}$. It is given that $Q(3.35) = 5\times10^{-4}$. (5)

5) Discuss the Gram-Schmidt orthogonalization procedure for representing any set of M energy signals, $\{s_i(t)\}$, as linear combinations of N orthonormal basis functions. (5)

6) Write a brief note on intersymbol interference and a practical method for controlling it. (4)

7) Write short notes on the following: (a) Principle of a Rake demodulator, (b) Granular noise in Delta modulation, (c) QPSK transmitter and receiver. (6)

8) List the requirements to be fulfilled for a system to be described as a spread spectrum system. (2)

9) Consider the four-stage shift register shown below. The initial state of the register is 1000. Obtain the output sequence and demonstrate the balance and run property as applied to a PN sequence. Also, calculate and plot the autocorrelation function of the PN sequence produced by this shift register. (7)

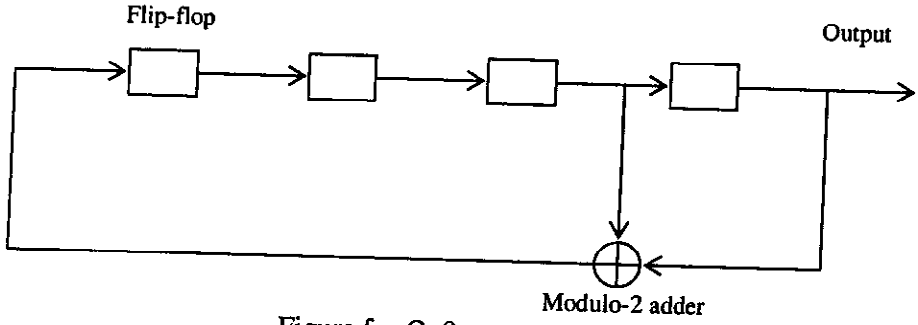


Figure for Q. 9

Good luck!