BITS, Pilani-Dubai
Dubai International Academic City

B.E. (Hons.), EEE, IV Year, II Semester, 2009-2010
Comprehensive Examination

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

*Note:- Answer all questions. This question paper has **two** pages.*

1. A delta modulator is fed by the message signal $m(t) = 4\sin 2\pi(10)t + 4\sin 2\pi(20)t$. Determine the minimum sampling frequency required to prevent slope overload, assuming that the step size of the modulator is 0.1π. (3 marks)

2. Condider the set of three signals defined below:

$$s_1(t) = \begin{cases} 2, & 0 \le t \le T/2 \\ 0, & otherwise \end{cases}$$

$$s_2(t) = \begin{cases} -2, & T/2 \le t \le T \\ 0, & otherwise \end{cases}$$

$$s_3(t) = \begin{cases} 3, & 0 \le t \le T/2 \\ 1, & T/2 < t \le T \\ 0, & otherwise \end{cases}$$

Obtain the basis set using Gram-Schmidt procedure. Also, obtain the vector representation of the three signals and indicate them as points in the signal space. (4 + 2 = 6 marks)

3. A binary baseband digital communication system employs the signal

$$s(t) = \begin{cases} \dfrac{1}{T_s}, & 0 \le t \le T_s \\ 0, & otherwise \end{cases}$$

Determine the output of the matched filter of this signal. If, instead of a matched filter, the signal $s(t)$ is passed through a correlator, then, find the correlator output. Comment on the output sample value for both cases at $t = T_s$. (3 + 2 + 1 = 6 marks)

4. For a (6, 3) code, the generator matrix is as given below. Find the transmitted information word if the received word is 100011. (4 marks)

$$[G] = \begin{bmatrix} 1\,0\,0\,1\,0\,1 \\ 0\,1\,0\,0\,1\,1 \\ 0\,0\,1\,1\,1\,0 \end{bmatrix}$$

5. Derive the expression for probability of bit error for FSK using a coherent matched filter (or correlation) detector. Assume orthogonal tone spacing. (6 marks)

6. A communication system consists of three possible messages. The probability of message A is p, and the probability of message B is also p. Plot the entropy as a function of p. (3 marks)

7. Write short notes on the following:
   a) Implementation of an early-late gate synchronizer
   b) Minimum shift keying
   c) Frequency-hopping spread spectrum
   d) Trellis coding (3 X 4 = 12 marks)

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BITS, Pilani-Dubai
Dubai International Academic City

BE (Hons.) EEE, IV Year, SecondSemester, 2009-10
Test – 2 (Open Book)

Course Title: Digital Communication (Elective)   Course No.: EEE C 416
Max. Marks: 20   Weightage: 20%   Duration: 50 minutes

Answer all the questions.

1. For a Gaussian random variable with zero mean and variance 10^{-8}, find the probability that the value of the random variable exceeds 2×10^{-4}. Express your answer in terms of both the Q-function and the error complementary function. (4 marks)

2. You are asked to design a (7,3) code that can correct single-bit errors.
   a) Derive the parity check matrix [H] for your code.
   b) Derive the generator matrix [G] for your code.
   c) Find the code word for the message 111.
   d) Demonstrate how an error in the seventh bit transmitted is corrected. (8 marks)

3. Binary information is transmitted using baseband signals of the form shown below. Design a matched filter detector, and find the probability of bit error, assuming that the additive noise has a two-sided power spectral density of 0.5×10^{-3} watt/Hz. (8 marks)

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B.E. (Hons.), EEE, IV Year, II Semester, 2009-2010
Test #1 (Closed Book)

Course No. / Course Title: EEE C416 / Digital Communication (Elective)
Duration: 50 minutes   Max. Marks: 25   Weightage: 25%

Note:- Answer all questions

1. An audio signal $m(t) = 2\cos 1000\pi t$ is quantized using delta modulation. Find the signal-to-quantization noise ratio. Assume that the sampling frequency chosen is eight times the Nyquist rate. (5 marks)

2. (a) Explain, with a block diagram, the working of a "counting quantizer" using ramp generator and binary counter for performing analog-to-digital conversion. (5 marks)

    (b) Obtain the required clock frequency of the above counting quantizer if a four-bit counter is used. Assume a voice signal with a maximum frequency of 3 kHz. The slope of the ramp is 10^6 volts/sec, and the amplitudes of the signal range from 0 to 10 volts. (5 marks)

3. Write a brief note on the desirable properties of a line code. Illustrate your answer with appropriate line codes meeting one or more of these properties. (5 marks)

4. Three message signals are to be sent using time-division multiplexed PAM. Suppose that the maximum frequency of each of the first two signals is 5 kHz and that the maximum frequency of the third signal is 10 kHz. Design the multiplex system and draw a block diagram. (5 marks)

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BITS PILANI-DUBAI
Dubai International Academic City, Dubai
BE (Hons.) EEE Fourth Year, II Semester, 2009-2010
**Quiz #2**

Digital Communication / EEE C416
Duration: 20 min   Max. Marks: 7   Weghtage: 7%

Name: _____

ID No.: _____

Figure below shows a four-stage feedback shift register. The initial state of the register is 1000.

    a) Find the output sequence of the shift register. (3 marks)
    b) Using the above result, demonstrate the balance property and run property of the PN sequence. (1.5 + 2.5 = 4 marks)

Mod-2 adder

BITS, PILANI-DUBAI
BE (Hons.) EEE, Fourth Year, II Semester, 2009-2010
Quiz #1
EEE C416: DIGITAL COMMUNICATION
Max. Marks: 8   Weightage: 8%   Duration: 20 minutes
Set B
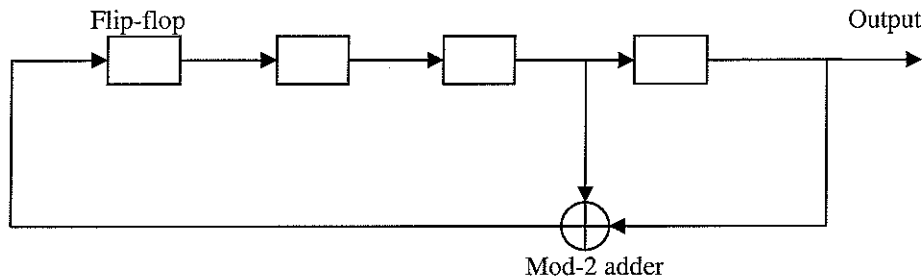
1. By making use of their definitions, obtain the relationship between the Q-function and the error-complementary function.

2. Sketch the FSK power spectral density for orthogonal tone spacing and mark all details clearly.

3. Find the minimum average length of a code with four messages with probabilities 0.125, 0.125, 0.25, and 0.5, respectively.