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06EC61

Sixth Semester B.E. Degree Examination, June/July 2011

Digital Communication

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. *Missing data be suitably assumed.*

PART – A

1 a. Briefly explain the various basic signal processing operations in a digital communication system. **(06 Marks)**

b. Consider the message signal $g(t) = A\cos(2\pi f_0 t)$. Plot the spectrums of the discrete-time signal $g_\delta(t)$ derived by sampling $g(t)$ for the sampling rates: i) $f_s = f_0$, ii) $f_s = 3f_0$. **(06 Marks)**

c. A low pass signal g(t) is sampled to get s(t) using flat top sampling method. Obtain the expression for the sampling signal s(t) and its spectrum. Hence show that flat top sampling leads to amplitude distortion, and explain how it is corrected during reconstruction. **(08 Marks)**

2 a. Explain the three basic functions of a regenerative repeater in a PCM system, with a block diagram of the regenerative repeater. **(06 Marks)**

b. Five message signals $g_1(t)$, $g_2(t)$, $g_3(t)$, $g_4(t)$ and $g_5(t)$ having bandwidths 2 KHz, 2 KHz, 2 KHz, 3 KHz and 3 KHz are to be transmitted on a time division multiplexed basis using a common channel. Setup a scheme for accomplishing this multiplexing requirement with each message signal sampled at its Nyquist rate. Find the minimum transmission bandwidth of the channel. **(06 Marks)**

c. Derive an expression for the output signal-to-quantization noise ratio of a uniform quantizer in terms of step size of the quantizer. Hence, show that for a mid-tread type uniform quantizer the SNR is $(SNR)_0 = (6n - 7.2)\,dB$ where "n" is the number of bits per sample. Assume a loading factor of 4 in the qunatizer. **(08 Marks)**

3 a. A delta modulator system is designed to operate at 10 times the Nyquist rate for a signal with a 10 KHz bandwidth. Determine the maximum SNR for a 8 KHz input sinusoid assuming no slope over load error. **(04 Marks)**

b. With a neat block diagram, explain how an optic fiber link is used for the transmission of digital data. **(08 Marks)**

c. Consider a random binary sequence where bits are statistically independent and equally likely. Determine the power spectral density for the NRZ polar format representation of the binary sequence. Plot the power spectra. **(08 Marks)**

4 a. A computer puts out binary data at the rate of 64 kilobits per second. The output is transmitted using a base band binary PAM system that is designed to have a raised cosine spectrum. Determine the transmission bandwidth required for each of the following roll off factors : i) $\alpha = 0.0$ ii) $\alpha = 0.5$ iii) $\alpha = 0.75$ iv) $\alpha = 1.0$ **(05 Marks)**

b. The binary data 0011011101 are applied to the input of a duobinary system with precoder. Construct the precoder output, duobinary coder output and corresponding receiver output for (i) initial bit 0, (ii) initla bit 1. Suppose that due to error during transmission, the level produced by second digit is reduced to zero. Construct the new receiver output. Write the necessary equations and procedures at each step. **(10 Marks)**

c. Write a short note on EYE PATTERN. **(05 Marks)**

PART – B

5 a. With the block diagrams of QPSK transmitter and receiver, explain the generation and demodulation of a QPSK wave. **(08 Marks)**

b. The binary sequence 11001000110 is applied to a DPSK transmitter. Draw the block diagram of the transmitter. Illustrate the generation of the DPSK signal and sketch the resulting waveform at the DPSK transmitter output. **(08 Marks)**

c. An FSK system transmits binary data at the rate of 2×10^6 bits per second. During the source of transmission, AWGN of zero mean and two sided power spectral density 10^{-20} watts per hertz is added to the signal. The amplitude of the received sinusoidal wave for digit 1 or 0 is 1 microvolt. Determine the average probability of symbol error assuming non-coherent detection. **(04 Marks)**

6 a. Using the Gram-Schmidt orthogonalization procedure, find a set of orthonormal basis functions to represent the 4 signals $s_1(t)$, $s_2(t)$, $s_3(t)$ and $s_4(t)$ shown in the Fig.Q6(a) below. Express each of these signals in terms of the set of basis functions. **(12 Marks)**

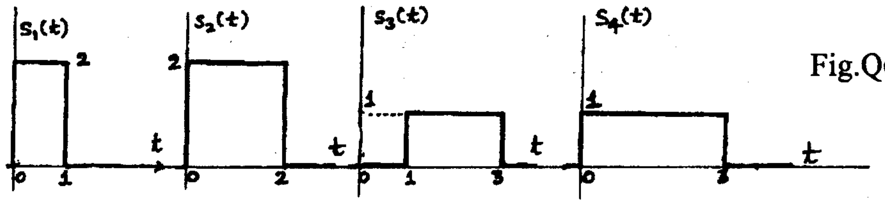

Fig.Q6(a)

b. Explain the importance of geometric interpretation of signals. Illustrate the geometric representation of signals for the case of a 2-dimensional signal space with 3 signals. **(08 Marks)**

7 a. With block diagrams of a detector and vector receivers, explain the working of a correlation receiver. **(08 Marks)**

b. What is a matched filter? Show that the spectrum of the output signal of a matched filter with the matched signal as input is proportional to the energy spectral density of the input signal. **(06 Marks)**

c. Consider the signal s(t) shown in Fig.Q7(c). Determine the impulse response of the matched filter. Plot the impulse response and the matched filter output as a function of time.

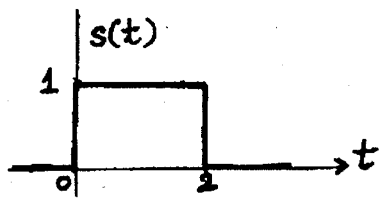

Fig.Q7(c)

(06 Marks)

8 a. A periodic PN sequence (maximum-length sequence) of period 7 is given : $\{C_n\}$ = 00111010011101---. State and verify the balance property and run property of the sequence. **(05 Marks)**

b. A spread spectrum communication system has the following parameters :

Information bit duration = T_b = 4 milli secs , PN chip duration = T_c = 2 micro secs.

Find the bit rate of the binary data, PN sequence length, bandwidth of the PN sequence and processing gain of the system. **(05 Marks)**

c. What is frequency hop spread spectrum? Describe the working of a frequency hop spread MFSK system employing slow-frequency hopping technique. **(10 Marks)**

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