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## Sixth Semester B.E. Degree Examination, June/July 2013

### Digital Communication

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting at least TWO questions from each part.**

#### PART – A

- 1 a. Explain the sampling theorem for low pass signals and derive the interpolation formula. (09 Marks)
- b. With a neat block diagram, explain the scheme for signal reconstruction for practical sampling. (06 Marks)
- c. Let E denote the energy of a strictly band limited signal  $g(t)$ . Show that E may be expressed in terms of the sample values of  $g(t)$ , taken at the Nyquist rate as,  $E = \frac{1}{2w} \sum_{n=-\infty}^{\infty} \left| g\left(\frac{n}{2w}\right) \right|^2$  where w is the highest frequency component of  $g(t)$ . (05 Marks)
- 2 a. Derive the expression for signal to quantization noise ratio (SNR) and show that for uniform quantization, each bit in the codeword of a PCM contributes 6 dB to SNR. (08 Marks)
- b. Six independent message sources of bandwidths w, w, 2w, 2w, 3w and 3w hertz are to be transmitted on TDM. Set up a scheme to accomplish this requirement, with each message signal sampled at its Nyquist rate. (05 Marks)
- c. The signal  $m(t) = 6 \sin(2\pi t)$  Volts, is transmitted using 4-bit binary PCM system. The quantizer is of midriser type with a step size of 1 Volt. The sampling frequency is 4 Hz with samples taken at  $t = \pm \frac{1}{8}, \pm \frac{3}{8}, \pm \frac{5}{8}, \dots$  sec. Sketch the PCM wave for one complete cycle of the input. (07 Marks)
- 3 a. With a neat block diagram, explain the delta modulation system and illustrate its quantization error. (08 Marks)
- b. Derive the expression for power spectral density of NRZ bipolar format. (07 Marks)
- c. Explain T<sub>1</sub> carrier system with its compounding characteristics. (05 Marks)
- 4 a. Explain the Nyquist criterion for distortionless baseband binary transmission and obtain the ideal solution for zero ISI. (08 Marks)
- b. For a binary sequence 10110001, construct (i) RZ polar format, (ii) Manchester format. (04 Marks)
- c. The binary data 011100101 is applied to the input of a modified duobinary system.
  - i) Construct the modified duobinary coder output and receiver output with a precoder.
  - ii) Due to transmission error, the level produced by the third digit is zero, construct the new receiver output. (08 Marks)

#### PART – B

- 5 a. Obtain the expression for probability of symbol error of coherent binary FSK. (09 Marks)
- b. Compare the probability of symbol errors for basic digital modulation formats and explain how the probability of error depends on the distance between the message points in signal space diagram. (04 Marks)
- c. With a neat block diagram, explain the differential phase shift keying. Illustrate the generation of differentially encoded sequence for the binary data 1100100010. (07 Marks)

- 6 a. With the conceptualized model of a digital communication system, explain the Gram-Schmidt orthogonalization procedure. (10 Marks)
- b. 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.Q6(b). Express each of these signals in terms of the set of basis functions. (10 Marks)

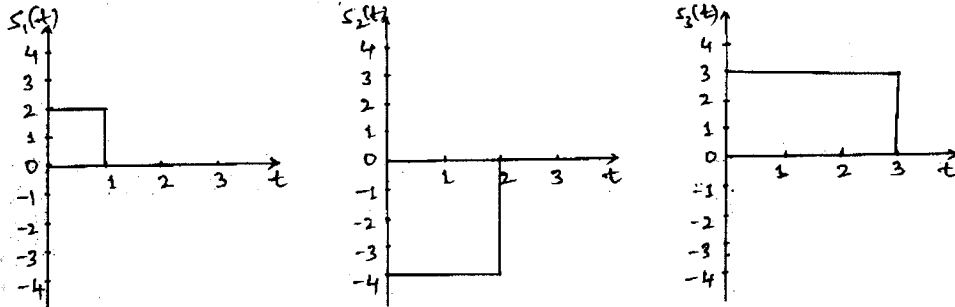
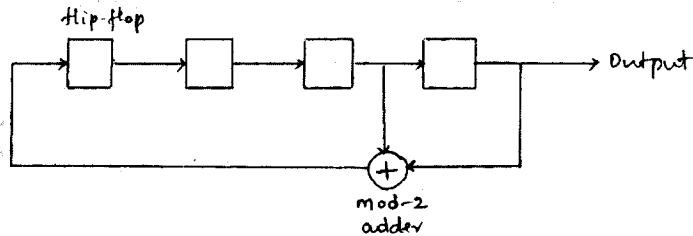


Fig.Q6(b)

- 7 a. Explain the maximum likelihood detection process and obtain the decision rule. (10 Marks)
- b. Derive the impulse response of a matched filter receiver and explain any two properties of matched filter. (10 Marks)
- 8 a. Explain frequency hop spread m-ary frequency shift keying with a neat block diagram and illustrate the slow frequency hopping. (08 Marks)
- b. Find the output sequence of the shift register shown in Fig.Q8(b). The initial state of the register is 1000. Demonstrate the balance property and run property of a PN sequence. Calculate and plot the autocorrelation function of the PN sequence. (07 Marks)



- c. In a DS/BPSK system, the feedback shift register used to generate the PN sequence has length  $m = 19$ . The system is required to have a probability of error due to externally generated interfering signals that doesn't exceed  $10^{-5}$ . Calculate the processing gain and antijam margin in decibels. Use  $\text{erf}(3) = 0.99998$ . (05 Marks)

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