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## Sixth Semester B.E. Degree Examination, June/July 2016

### 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 sampling theorem of low pass signals and derive the interpolation formula. (08 Marks)
- b. A low pass signal  $x(t)$  has spectrum  $X(f)$  given by,

$$X(f) = \begin{cases} 1 - \frac{|f|}{200}; & |f| < 200 \\ 0 & \text{Elsewhere} \end{cases}$$

- Sketch the spectrum  $X_s(f)$  for  $|f| < 200$  Hz if  $x(t)$  is ideally sampled at  $f_s = 300$  Hz. (06 Marks)
- c. A band pass signal  $g(t)$  with a spectrum shown in Fig.Q1(c) is ideally sampled. Sketch the spectrum of sampled signal at  $f_s = 25$  Hz and  $f_s = 45$  Hz. Indicate if and how the signal can be recovered.

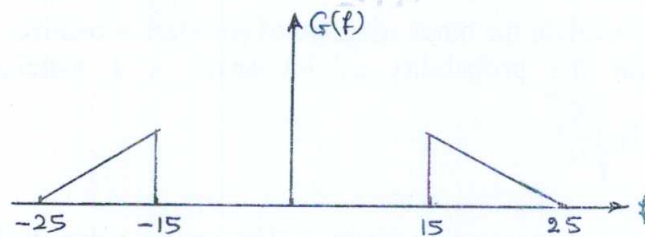


Fig.Q1(c)

(06 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. For a binary PCM signal, determine L if the compression parameter  $\mu = 100$  and the minimum  $[SNR]_0$  dB = 45 dB. Determine the  $[SNR]_0$  dB with this value of L. (06 Marks)
- c. With a neat block diagram and waveform, explain time division multiplexing. (06 Marks)
- 3 a. Explain the principles of delta modulator. With relevant figure and mathematical expressions, explain the functioning of DM transmitter and receiver. (08 Marks)
- b. For a binary sequence 111000110101 draw the digital format waveforms corresponding to:  
i) Bipolar NRZ waveform and ii) 8-ary signaling waveform. (06 Marks)
- c. Derive an expression for power spectral density of bipolar NRZ format and plot the same with respect to frequency. (06 Marks)
- 4 a. What is correlative coding? Explain duo binary coding with and without precoding. (08 Marks)
- b. The binary data 011100101 are applied to the input of a modified duo binary system:  
i) Construct the modified duo binary coder output and corresponding receiver output without a precoder.  
ii) Suppose that due to error in transmission, the level produced by the third digit is reduced to zero. Construct a new receiver output. (07 Marks)
- c. With a neat block diagram, explain the concept of adaptive equalization. (05 Marks)

**PART - B**

- 5 a. With neat block diagram, explain DPSK transmitter and receiver. Illustrate the generation of differentially encoded sequence for the binary input sequence 00100110011110. (12 Marks)
- b. A binary data is transmitted over an AWGN channel using binary phase shift keying at the rate of 1 Mbps. It is desired to have average probability of error  $P_e \leq 10^{-4}$ . Noise power spectral density is  $N_{0/2} = 10^{-12}$  W/Hz. Determine the average carrier power required at the receiver input, if the detector is of coherent type. Take  $\text{erfc}(3.5) = 0.00025$ . (08 Marks)

- 6 a. Write a note on Gram-Schmidt orthogonalization procedure. (08 Marks)
- b. Consider the signal  $s_1(t)$ ,  $s_2(t)$ ,  $s_3(t)$  and  $s_4(t)$  as given below in Fig.Q6(b).

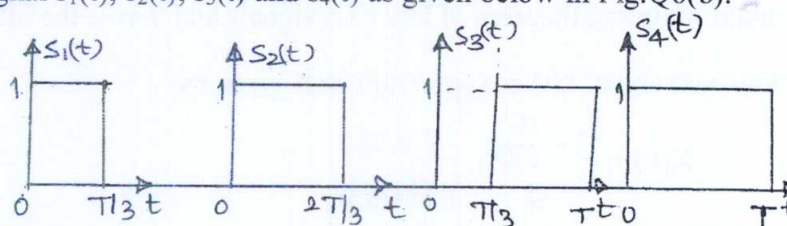


Fig.Q6(b)

Find an orthonormal basis for these set of signals using Gram-Schmidt orthogonalization procedure. (12 Marks)

- 7 a. Draw and explain the block diagram of correlation receiver. (08 Marks)
- b. Show that the probability of bit error of a matched filter receiver is given by

$$P_e = \frac{1}{2} \text{erfc} \sqrt{\frac{E_b}{N_0}}$$

(12 Marks)

- 8 a. What is spread spectrum technique? How are they classified? (08 Marks)
- b. Explain properties of PN sequence. (06 Marks)
- c. A slow FH/MFSK system has the following parameters:

The number of bits/MFSK symbol = 4

The number of MFSK symbols per hop = 6

Calculate processing gain of the system. (06 Marks)

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