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10EC/TE61

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018

**Digital Communication**

Time: 3 hrs.

Max. Marks:100

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

**PART - A**

- 1 a. State and prove sampling theorem of low pass signal. Draw the diagrams of  $G(f)$  and sampled signal  $G_s(f)$ . Derive interpolation formula for reconstruction of original signal. (12 Marks)
- b. A signal  $g(t) = 2 \cos(400\pi t) + 6 \cos(640\pi t)$  is ideally sampled at 500 Hz. If the sampled signal pass through an ideal LPF with a cutoff frequency of 400 Hz, what components will appear in the filter output? (06 Marks)
- c. What is 'aperture effect'? How is it eliminated? (02 Marks)
- 2 a. Derive an expression for maximum signal to quantization noise ratio for PCM system that employs linear quantization technique. Show that normalized signal quantization noise ratio in dB is given by  $(SNR)_{dB} = 4.8 + 6N$ . (08 Marks)
- b. Explain the need for non-uniform quantization. Also explain  $\mu$ -law and A-law companding. (08 Marks)
- c. Three independent message sources of bandwidth 1 kHz, 1 kHz, 2 kHz respectively are to be transmitted using TDM scheme. Determine the speed of commutator if each signal is sampled at Nyquist rate. Also find minimum transmission band width. (04 Marks)
- 3 a. With neat diagrams, explain the operation of Delta modulation. Mention the drawbacks of delta modulation. (08 Marks)
- b. For the binary bit sequence 1001001 draw the waveforms using:
  - i) Unipolar NRZ
  - ii) Unipolar RZ
  - iii) Bipolar NRZ
  - iv) Manchester coding waveform. (04 Marks)
- c. Obtain power spectral density of NRZ unipolar format and draw its normalized PSD. (08 Marks)
- 4 a. Describe Nyquist's criteria for distortionless baseband transmission. (06 Marks)
- b. Define ISI. Write a brief note on eye pattern. (08 Marks)
- c. Explain briefly the need for a precoder in a duo binary signaling. For the binary sequence 001101001, obtain precoded sequence, duobinary encoder output and recovered output. (06 Marks)

**PART - B**

- 5 a. Derive an expression for probability of error ' $P_e$ ' of a coherent binary ASK. (10 Marks)
- b. A binary FSK system transmits data at a rate of 2 Mbps over an AWGN channel. The noise is zero mean with PSD,  $\frac{N_0}{2} = 10^{-20}$  W/Hz. The amplitude of received signal in the absence of noise is  $1 \mu\text{V}$ . Determine the average probability of error for coherent detection of FSK. Take  $\text{erfc}\sqrt{6.25} = 0.00041$ . (06 Marks)
- c. A binary data stream 101101 is to be transmitted using DPSK. Determine the encoded and decoded output. (04 Marks)

- 6 a. With a diagram, explain the model of digital communication system. (06 Marks)  
 b. What do you mean by an optimum receiver with reference to a digital modulation scheme? Write the scheme of a correlation receiver and describe its feature. (08 Marks)  
 c. Find the output of the matched filter and determine the maximum SNR at output if the input  $S(t)$  is a rectangular pulse of amplitude  $A$  and duration  $T$ . (06 Marks)
- 7 a. Write a brief note on maximum-likelihood detector. (06 Marks)  
 b. Explain briefly about adaptive equalization. (06 Marks)  
 c. Three signals  $S_1(t)$ ,  $S_2(t)$  and  $S_3(t)$  are equiprobable and are given by
- $$S_1(t) = \sqrt{\frac{2}{T}} \cos\left(\frac{4\pi t}{T}\right) \quad 0 \leq t \leq T$$
- $$S_2(t) = \sqrt{\frac{2}{T}} \cos\left(\frac{8\pi t}{\pi}\right) \quad 0 \leq t \leq T$$
- $$S_3(t) = \sqrt{\frac{2}{T}} \cos\left(\frac{12\pi t}{\pi}\right) \quad 0 \leq t \leq T$$
- i) Sketch the signal space and decision boundaries for this set of signals. (08 Marks)  
 ii) Show that signal space can be reduced to two dimensions. (08 Marks)
- 8 a. With neat diagram, explain direct sequence spread spectrum system. Write the formula to find processing gain, average probability of error. (06 Marks)  
 b. A PN sequence is generated using 4-stage linear feedback shift register as shown in Fig.Q8(b) with initial condition  $C_3C_2C_1C_0 = 1000$ . This sequence is used in a slow FH/MFSK system.

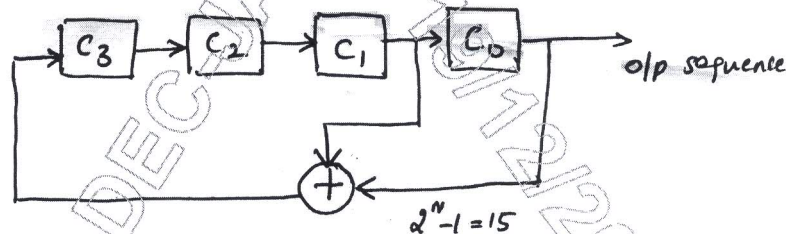


Fig.Q8(b)

- Determine the following:
- Period of PN sequence.
  - PN sequence for one periodic length.
  - Verify the three properties of PN sequence. (08 Marks)
- c. In a fast FH/MFSK system, the signal has following parameters:
- Number of bits per MFSK symbol  $K = 2$
  - Number of MFSK segment per hop = 3
  - Total number of frequency hops = 8
  - Number of hops per MFSK symbol = 2
  - Period of PN sequence  $L = 15$
- Determine the relation between bit rate and chip rate.
  - Sketch the variation of frequency of transmitted signal with time. Assume binary data sequence to be 01101100 and one period of PN sequence is 111100010011010. (06 Marks)

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