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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 $G_\delta(f)$. 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 μ-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 'Pe' 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, $\frac{NO}{2} = 10^{-20}$ W/Hz. The amplitude of received signal in the absence of noise is 1 μv. 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(1) 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

$$S_1(t) = \sqrt{\frac{2}{T}} \cos\left(\frac{4\pi t}{T}\right) \quad 0 \le t \le T$$

$$S_2(t) = \sqrt{\frac{2}{T}} \cos\left(\frac{8\pi t}{\pi}\right) \quad 0 \le t \le T$$

$$S_3(t) = \sqrt{\frac{2}{T}} \cos\left(\frac{12\pi t}{\pi}\right) \quad 0 \le t \le T$$

i) Sketch the signal space and decision boundaries for this set of signals.

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.

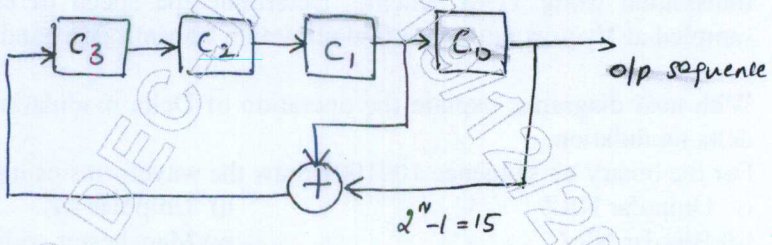

Fig.Q8(b)

Determine the following:

i) Period of PN sequence.

ii) PN sequence for one periodic length.

iii) 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

i) Determine the relation between bit rate and chip rate.

ii) 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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