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A 1227

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Sixth Semester

Electronics and Communication Engineering

EC 341 — DIGITAL COMMUNICATION

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State sampling theorem.

2. Define Quantization error.

3. Differentiate : Coherent and Non-Coherent detection.

4. An analog signal is quantized and transmitted by using a PCM system. If each sample at the receiving end of the system must be known to within ± 0.5 percent of the peak-to-peak full-scale value. How many binary digits must each sample contain?

5. What do you mean by M-ary orthogonal signals?

6. List the applications of matched filters.

7. Define Hamming distance of a block code.

8. Show that the code $C = \{000, 100, 011, 111\}$ is not cyclic.

9. A spread spectrum communication system has Information bit duration $T_b = 4.095$ ms and PN chip duration $T_C = 1\,\mu s$. Find the processing gain.

10. Compare fast and slow frequency hopping systems.

PART B — (5 × 16 = 80 marks)

11. (a) A compact disc [CD] recording system samples each of two stereo signals with a 16-bit analog-to-digital converter (ADC) at 44.1 kb/s.

(i) Determine the output signal to quantization noise ratio for a full-scale sinusoid. (8)

(ii) The bit stream of digitized data is augmented by the addition of error-correcting bits, clock extraction bits and display and control bit fields. These additional bits represent 100 percent overhead. Determine the output bit rate of the CD recording system. (8)

Or

(b) (i) Describe the principle and operational procedure for Delta Modulation. Draw appropriate waveforms. (8)

(ii) A delta modulation system is designed to operate at 3 times the Nyquist rate for a signal with a 3 KHz bandwidth. The quantizing step size is 250 mV.

(1) Determine the maximum amplitude of a 1 KHz input sinusoid for which the delta modulator does not show slope overload. (4)

(2) Determine the postfiltered output signal-to-quantiting noise ratio for the signal of Part (1). (4)

12. (a) A signal $m_1(t)$ is band limited to 3.6 KHz and three other signals $m_2(t)$, $m_3(t)$ and $m_4(t)$ – are band limited to 1.2 KHz each. These signals are to be transmitted by means of time division multiplexing.

(i) Setup a scheme for accomplishing this multiplexing requirement with each signal sampled at its Nyquist rate. (4)

(ii) What must be the speed of the Commutator (in samples per second)? (4)

(iii) If the commutator output is quantized with L = 1024 and the result is binary – coded, what is the output bit rate? (4)

(iv) Determine the minimum transmission bandwidth of the channel. (4)

Or

(b) (i) Describe the process of correlative coding and precoding. (12)

(ii) A communication channel of bandwidth 75 KHz is required to transmit binary data at a rate of 0.1 Mb/s using raised cosine pulses. Determine the roll off factor α. (4)

13. (a) Find the union bound for

(i) Coherent binary PSK and (6)

(ii) Coherent binary FSK. (6)

Compare the results with the actual values of probability of error for these two schemes. (4)

Or

(b) The equivalent noise bandwidth of a band-pass signal is defined as the value of bandwidth that satisfies the relation

$4BS(f_c) = P$

Where, $2B$ – noise equivalent centered at the mid-band frequency (f_c).

$S(f_c)$ – maximum value of the power spectral density of the signal at $f = (f_c)$

P – average power of the signal.

Show that the equivalent noise bandwidths of binary PSK, QPSK and MSK normalized with respect to the data rate (measured in b/s) are as follows :

Type of Modulation	Noise Bandwidth/Bit rate
Binary PSK	1.0
QPSK	0.5
MSK	0.62

using this definition of bandwidth, calculate the bandwidth efficiency of binary PSK, QPSK and MSK signals.

14. (a) For a (6, 3) systematic linear block code, the three parity-check bits C_4, C_5 and C_6 are formed from the following equations :

$C_4 = d_1 \oplus d_3$

$C_5 = d_1 \oplus d_2 \oplus d_3$

$C_6 = d_1 \oplus d_2$

(i) Write down the generator matrix G. (4)

(ii) Construct all possible code words. (4)

(iii) Suppose that the received word is 010111. Decode this received word by finding the location of the error and the transmitted data bits. (8)

Or

(b) Show that the Hamming distance measure has the following properties :

(i) $d(a, b) \geq 0$ with = 0 if and only if $a = b$. (5)

(ii) $d(a, b) = d(b, a)$. (5)

(iii) $d(a, c) \leq d(a,b) + d(b, c)$. (6)

15. (a) 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 does not exceed 10^{-5}. Calculate the following system parameters in decibels :

(i) Processing gain. (8)

(ii) Antijam margin. (8)

Or

(b) Explain the following :

(i) Direct sequence spread spectrum systems. (10)

(ii) Generation and correlation properties of spread spectrum systems. (6)
