

AMIETE – ET (OLD SCHEME)Code: AE21
Time: 3 Hours**JUNE 2009**Subject: DIGITAL COMMUNICATIONS
Max. Marks: 100**NOTE: There are 9 Questions in all.**

- Question 1 is compulsory and carries 20 marks. Answer to Q. 1. A must be written in the space provided for it in the answer book supplied and nowhere else.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or the best alternative in the following: (2×10)a. In an alphabet of $M = 2^K$ symbols, if $K = 1$ the system will be termed

- (A) quaternary. (B) trinary.
(C) binary. (D) M-ary.

b. A baud limited signal having no spectral components above f_m hertz can be determined uniquely by values sampled at uniform intervals of

- (A) $T_s \leq \frac{1}{4f_m}$ sec. (B) $T_s \leq \frac{1}{2f_m}$ sec.
(C) $T_s > \frac{1}{2f_m}$ sec. (D) $T_s \leq \frac{1}{f_m}$ sec.

c. In the design of correlator and matched filter for the baseband demodulation, if the signal waveform is $s(t)$ of duration T sec, then the impulse response of the filter will be

- (A) $h(t) = s(t - T)$. (B) $h(t) = s(t + T)$.
(C) $h(t) = s(T - t)$. (D) $h(t) = s(t - 2T)$.

d. In the implementation of a differential 8-PSK (D8PSK) modulator, to each phase we assign a

- (A) 2-bit message. (B) 4-bit message.
(C) 3-bit message. (D) 5-bit message.

e. The probability of a bit-error for coherently detected BPSK system, with usual notations is

- (A) $Q\left(\sqrt{\frac{2E_b}{N_o}}\right)$. (B) $Q\left(\frac{E_b}{2N_o}\right)$.
(C) $Q\left(\frac{2E_b}{N_o}\right)$. (D) $Q\left(\frac{\sqrt{E_b}}{N_o}\right)$.

f. In waveform coding, the redundant bits added to data sequences can be used for

- (A) getting a high noise power at the destination.
(B) increasing the probability of a bit error.
(C) the detection and correction of errors.
(D) increasing the transmitted power.

$$G = \begin{bmatrix} 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 & 1 \end{bmatrix}$$

- g. A (6, 3) linear block code uses a generator matrix given by message vector $[1 \ 1 \ 0]$ will be,
- (A) 110110. (B) 010110.
(C) 101110. (D) 100110.
- h. An optimal decoding method for minimising the probability of sequence error is
- (A) the (n-k) stage shift register scheme.
(B) the Bahl algorithm.
(C) the maximum a posteriori algorithm.
(D) the viterbi algorithm.
- i. The processing gain for frequency hopping systems is defined as
- (A) the ratio of the data rate to the number of coefficients chosen pseudo randomly.
(B) the ratio of code chip rate to data rate.
(C) the ratio of the data rate to the hopping band.
(D) the ratio of the hopping band to the data rate.
- j. In the study of Jamming considerations, the noise power spectral density due to the Jammer is evaluated as
- (A) the ratio of thermal noise power to the spread-spectrum bandwidth.
(B) the ratio of received signal power to the spread-spectrum bandwidth.
(C) the ratio of average received Jammer power to the spread-spectrum bandwidth.
(D) the ratio of spread-spectrum bandwidth to the average received Jammer power.

**Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.**

Q.2 a. What does sampling process provide to the communication engineer? Briefly explain

- (i) natural sampling.
(ii) quantisation noise.
(iii) quantizer saturation.

(11)

b. A waveform, $x(t) = 10 \cos\left(1000t + \frac{\pi}{3}\right) + 20 \cos\left(2000t + \frac{\pi}{6}\right)$ is to be uniformly sampled.

(i) What is the maximum allowable time interval between sample values that will ensure perfect signal reproduction?

(ii) If we want to reproduce one hour of this waveform how many sample values need to be stored?

(5)

Q.3 a. What is PCM as applied to baseband transmission? With a neat illustration, briefly describe the essential features of binary PCM. **(7)**

b. What is delta modulation technique? Comment on the motivation for this technique. **(4)**

c. A one-step linear predictive filter is to be used to sample a constant amplitude sinusoid. The ratio of sample frequency to sinusoid frequency is 10. Determine the prediction coefficient of the filter. **(5)**

- Q.4** a. “Power is not a useful way to characterize a digital waveform” – Comment. Briefly describe the likelihood ratio test. What is the meaning of the term “intersymbol interference”? (9)
- b. What is band-pass modulation? Distinguish between coherent detection and noncoherent detection. Mention the advantages and disadvantages of noncoherent detection. Give two examples for this type of system. (7)
- Q.5** a. What is FSK? With a neat block schematic describe the implementation for noncoherent FSK detection that uses bandpass filters and envelope detectors. (9)
- b. Give a brief error performance analysis for coherently detected binary orthogonal FSK. (7)
- Q.6** a. What is the feature of forward error correction type of error control? How are error correcting codes classified? Write a brief note on linear block codes. (7)
- b. Using the generator polynomial $g(x) = 1 + x + x^3$, generate a systematic codeword from the (7, 4) codeword set for the message vector $m = 1011$. (4)
- c. Use a dividing (feedback shift register) circuit to divide $V(x) = x^3 + x^5 + x^6$ by $g(x) = 1 + x + x^3$. Find the quotient and remainder terms. (5)
- Q.7** a. With a neat sketch for illustration, explain the encoding of a cyclic code in systematic form, with an $(n-k)$ – stage shift register. (8)
- b. What are the features of Hamming codes, extended Golay code and BCH codes? (8)
- Q.8** a. Fig.1 shows a convolutional encoder (rate $\frac{1}{2}, K = 3$). Write the state diagram representation for the encoder and explain. (9)

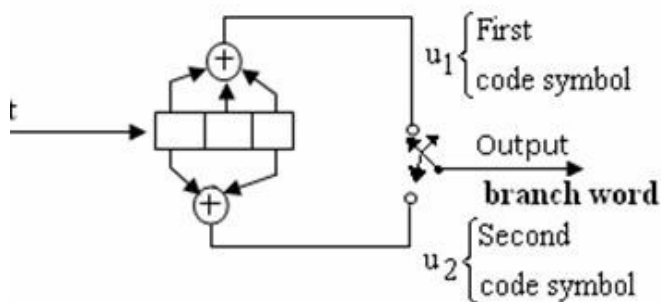


Fig.1

- b. What are the requirements to be fulfilled by a system to be called a spread-spectrum system? Write a brief note on ‘pseudonoise sequences’. (7)
- Q.9** a. With neat schematics, explain the direct sequence SSBPSK transmitter and receiver. (11)

- b. A total of 24 equal-power terminals are to share a frequency band through a code division multiple access system. Each terminal transmits information at 9.6 K bits/S with a DSS-BPSK modulated signal. Calculate the minimum chip rate of the PN code in order to maintain a bit error probability of 10^{-3} . Assume that the receiver noise is negligible with respect to the interference from the other users. **(5)**