

AMIETE – ET (OLD SCHEME)

Code: AE21
Time: 3 Hours

Subject: DIGITAL COMMUNICATIONS
Max. Marks: 100

DECEMBER 2010

NOTE: There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.
- The answer sheet for the Q.1 will be collected by the invigilator after half an hour of the commencement of the examination.
- 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. Signal to Quantization noise ratio in n-bit PCM system depend on
- (A) Sampling frequency employed
(B) Independent of the value of n
(C) Increases with increasing value of n
(D) Decreases with increasing value of n
- b. Which system has maximum probability of error
- (A) PSK (B) ASK
(C) FSK (D) BPSK
- c. When number of quantization level is 64 in PCM, the number of pulses in a code group will be
- (A) 2 (B) 4
(C) 6 (D) 16
- d. If S/N ratio of signal is 15 and bandwidth is 5 kHz, the channel capacity is
- (A) 10 Kbits/s (B) 20 Kbits/s
(C) 30 Kbits/s (D) 40 Kbits/s
- e. Cyclic codes are subclass of
- (A) Convolution codes (B) Linear Block codes
(C) BCH codes (D) Reed Solomon Codes
- f. The no of 1s in the length of PN sequence for a 4 stage shift register is
- (A) 5 (B) 6
(C) 7 (D) 8
- g. Slope overload in delta modulation can be avoided using
- (A) $\Delta/T_s \geq M'(t)$ (B) $\Delta/T_s \leq M'(t)$
(C) $\Delta/T_s = M'(t)$ (D) None

- h. The probability of error in ASK system
- (A) $\frac{1}{2} \operatorname{erfc}[E_s/4\eta]^{1/2}$ (B) $\frac{1}{2} \operatorname{erfc}[E_s/\eta]^{1/2}$
 (C) $\frac{1}{2} \operatorname{erfc}[0.6E_s/\eta]^{1/2}$ (D) $\frac{1}{2} \operatorname{erfc}[E_s/2\eta]^{1/2}$
- i. A DS spread spectrum has a 2.4576 Mcps code clock rate and 19.2 Kbps information rate. What is processing gain:
- (A) 64 (B) 128
 (C) 256 (D) 512
- j. The rate efficiency of (6,3) block code in % is
- (A) 25 (B) 50
 (C) 75 (D) 100

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

- Q.2** a. Explain how ISI can be reduced by pulse . Compare the performance degradation of communication filter due to noise interference and ISI. (8)
- b. Compare FH – SS with DS – SS technique. (8)
- Q.3** a. Explain Offset Quadrature Phase Shift Keying(QPSK). Make suitable sketch of its transmitter and receiver and explain in detail. (8)
- b. Represent the data bits 101001 by the bipolar NRZ waveform. Sketch the following digital modulation scheme for these waveform (8)
- (i) ASK (ii) FSK
 (iii) PSK
- Q.4** a. A Systematic block code (6, 3) has a generator matrix as follows:
- $$G = \begin{bmatrix} 100 : 110 \\ 010 : 011 \\ 001 : 111 \end{bmatrix}$$
- Find all its code vectors of this code. (8)
- b. Explain convolution codes. Design an encoder for convolution code using 3 shift register and taking 4 bit length of input data stream. (8)
- Q.5** a. A Parity check code has the parity check Matrix
- $$H = \begin{bmatrix} 101100 \\ 110010 \\ 011001 \end{bmatrix}$$
- (i) Determine the generator matrix
 (ii) Find the code word that begin 101
 (iii) Decode the received word 110110. (8)

- b. Draw the state diagram, and Trell's diagram for $K = 3$, code rate = $\frac{2}{3}$ generated by
- $$g_1(X) = X^2 + X$$
- $$g_2(X) = X + 1$$
- $$g_3(X) = X^2 + X + 1 \quad (8)$$

Q.6 a. Explain spread spectrum modulation. What is Pseudorandom Noise sequence? Write at least 6 properties for PN sequences. (8)

b. A Pseudorandom Noise sequence is generated using a four stage linear feedback shift register. A modulo 2 adder is used between output of fourth and third shift register. A feedback path is from adder to input of first shift register. The chip rate is 10^7 chips per second, calculate:

- (i) PN sequence length
- (ii) PN sequence period (8)

Q.7 a. Show that the impulse response of a matched filter $h(t)$ matched to a signal $s(t)$ is $h(t) = Ks(T - t)$. Where T is the symbol duration and k is the proportionately constant. (8)

b. Determine the probability of error P_e in frequency shift keying (FSK) (8)

Q.8 a. Draw the block diagram of delta modulation system and explain its working. (8)

b. A decimal number N was transmitted using seven bit even parity Hamming code. After transmission, it was received as 1101101. Is there any error introduced during transmission? What is the value of N ? (8)

Q.9 a. Derive an expression for output signal to quantization noise ratio in a commercial PCM system. (8)

b. A certain 8 bit uniform quantization PCM system can accommodate a signal ranging from $-1V$ to $+1V$. The RMS value of the signal is $0.5 V$. Calculate the signal to quantization noise ratio and express it in dB. (8)