AMIETE – ET (OLD SCHEME)

Code: AE21   **Subject: DIGITAL COMMUNICATIONS**
Time: 3 Hours   **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) $\frac{1}{2}\mathrm{erfc}[E_s/4\eta]^{1/2}$ (B) $\frac{1}{2}\mathrm{erfc}[E_s/\eta]^{1/2}$

(C) $\frac{1}{2}\mathrm{erfc}[0.6E_s/\eta]^{1/2}$ (D) $\frac{1}{2}\mathrm{erfc}[E_s/2\eta]^{1/2}$

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 = $\frac{1}{3}$ generated by

$$g_1(X) = X^2 + X$$
$$g_2(X) = X + 1$$
$$g_3(X) = X^2 + X + 1$$ **(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)**