

Total No. of Questions : 12]

SEAT No. : 

P1381

[Total No. of Pages : 4

**[4858] - 142**

**T.E. (E & TC) (Semester - I)**  
**DIGITAL COMMUNICATION**  
**(2008 Pattern)**

*Time : 3 Hours]**[Max. Marks : 100**Instructions to the candidates:*

- 1) *Answer any three questions from each section.*
- 2) *Answer to the two sections should be written in separate books.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Assume suitable data, if necessary.*

**SECTION - I**

**Q1)** a) With the help of detail diagram explain function of each block of digital communication system. **[8]**

- b) A voice signal (300 to 3300 Hz) is digitized such that the quantization distortion  $\leq \pm 0.1\%$  of peak to peak signal voltage. Assume a sampling rate of 8000 samples/s and a multilevel PAM waveform with 32 levels. Find the theoretical minimum system bandwidth that voids ISI. **[8]**

OR

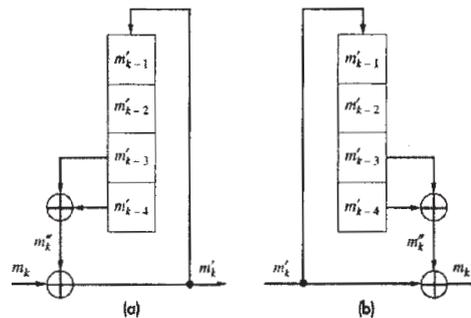
**Q2)** a) Compare PCM, DPCM, Delta modulation & Adaptive Delta modulation on the basis of Sampling Frequency, Bit rate & bandwidth requirement. **[8]**

- b) In the Compact Disc (CD) digital audio system, an analog signal is digitized so that the ratio of the Peak Signal power to Peak Quantization power is at least 96dB. Sampling Rate is 44.1 kilosamples/s. **[8]**

- i) How many quantization levels of analog signal are needed for  $(S/N_q)_{\text{peak}} = 96\text{dB}$ ?
- ii) How many bits per sample are needed for the number of levels found in part (a)?
- iii) What is the data rate in bits/s?

**P.T.O.**

- Q3)** a) Explain need of Line coding. State its properties. Draw and give mathematical expression of Power Spectral density for unipolar NRZ, Polar RZ, AMI, and Manchester. [10]
- b) A scrambler is shown in figure. Design the corresponding descrambler. If a sequence  $m_k = 10110000000001$  is applied to the input of this scrambler, determine the output sequence  $m'_k$ . Verify that if this  $m'_k$  is applied to the input of the scrambler, the output sequence  $m_k$ . [8]



OR

- Q4)** a) What is digital Hierarchy used in digital Communication system? Explain anyone with a neat sketch. [6]
- b) Explain Inter Symbol interference (ISI) with help of block diagram of a binary base band transmission system. Also explain Nyquist solution used for curing ISI. [8]
- c) Explain the use of Eye Diagram to measure ISI. [4]

- Q5)** a) Show that a narrowband random process  $X(t)$  can be completely represented in terms of its in phase and Quadrature components. [8]
- b) Two random processes  $z(t)$  and  $y(t)$  are given by [8]

$$z(t) = A \cos (\omega_c t + \phi)$$

$$y(t) = A \sin (\omega_c t + \phi)$$

Where  $A$  and  $\omega_c$  are constants and  $\phi$  is a uniform random variable over  $(0, 2\pi)$ . Find the auto correlation and cross correlation of  $z(t)$  and  $y(t)$ .

OR

- Q6)** a) Explain Ergodic process. If  $X(t) = A \cos (2 \pi f_c t + \phi)$  is random process with  $\phi$  as a random variable uniformly distributed over  $(0, 2\pi)$ . Prove that  $X(t)$  is ergodic in mean. [8]
- b) What is a Wide Sense Stationary Process? When A WSS R.P.  $X(t)$  is applied to input of LTI system with impulse response  $h(t) = 3 e^{-2t} u(t)$ , Find the mean value of system if  $E[X(t)] = 2$  and its autocorrelation. [8]

**SECTION - II**

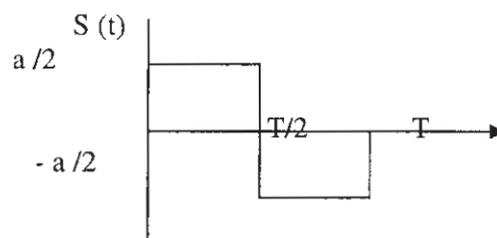
- Q7)** a) Draw and explain the block diagram of QPSK Transmitter & Receiver. Compare the Euclidean Distance 'd' of QPSK & Offset QPSK with the help of Signal Space representation. [10]
- b) 16 QASK has a lower error rate than 16 MPSK, but a higher error rate than QPSK. Prove the statement. [8]

OR

- Q8)** a) Compare the Euclidean Distance 'd' & Bandwidth of M-ary PSK, M-ary FSK with  $M = 2^n$  for  $n = 3, 4, 5$  and comment on the same. [10]
- b) The following bit streams are to be transmitted using DPSK scheme. [8]
- i) 1011100011
- ii) 0101000111

Determine and sketch the encoded sequence and transmitted phase sequence.

- Q9)** a) Consider the signal  $S(t)$  shown in fig. [8]



Determine the impulse response of a filter matched to this signal and sketch it as a function of time, Plot the matched filter output as a function of time.

- b) Derive the expression for the probability of error of a BPSK system. [8]

OR

- Q10)** a) What is Correlator? Compare its performance with Matched filter mathematically and relevant diagrams. [8]

- b) A BPSK signal is received at the input of a coherent receiver with amplitude 100mv and frequency 1MHz. The signal is corrupted with White noise of PSD  $10^{-9}$  W/Hz. If the data rate is  $10^{-4}$  bits/sec, find [8]
- Probability of Error
  - Error Probability if the local oscillator has a phase shift of  $\pi/6$
  - Error Probability if there is 10% mistiming in bit synchronization while sampling.
  - find  $P_e$  when both (ii) and (iii) occur.
- $\text{erfc}(1.50) = 0.03389$ ,  $\text{erfc}(1.5811) = 0.0254$ ,  $\text{erfc}(1.3692) = 0.0528$ ,  
 $\text{erfc}(1.2648) = 0.0736$ ,  $\text{erfc}(1.0953) = 0.1214$ ,  $\text{erfc}(1.6511) = 0.0196$

**Q11) a)** Draw the block diagram of Satellite communication and Write a short note on radio link budget analysis. [8]

- b) In a DSSS-BPSK system, the feedback shift register used to generate the PN sequence of length 15. The system is required to have an average probability of symbol error as  $10^{-5}$ . [8]

Calculate

- Processing gain
- Antijam Margin.

Given :

| X    | erfc(X)    |
|------|------------|
| 3.01 | 0.00002074 |
| 3.02 | 0.00001947 |
| 3.03 | 0.00001827 |
| 3.04 | 0.00001714 |

OR

**Q12) a)** Represent variation of the frequency of an fast hop spread spectrum system with binary FSK, having following parameters [8]

Number of bits per MFSK symbol  $K = 2$ .

Number of MFSK tones  $M = 2^k = 4$

Length of PN segment per hop  $k = 3$

Total number of frequency hops  $2^k = 8$

for the binary message of 01111110001001111010

Generate the PN Sequence for the message to be transmitted . The period of the PN sequence is  $2^4 - 1 = 15$  with initial shift register content of 1100.

- b) What is multi-user communication? Describe different multiple access techniques on the basis of channel sharing and applications. [8]

