Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – VI • EXAMINATION – WINTER 2012

Subject code: 161001 Date: 02/01/2013

Subject Name: Digital Communication

Time: 02.30 pm - 05.00 pm Total Marks: 70

Instructions:

1. **Attempt any five questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** State, prove and explain the sampling theorem. What is aliasing effect? **07**

(b) Draw and explain the block diagram of PCM transmitter and receiver. Explain the quantization process. **07**

Q.2 **(a)** Define the statistical mean, mean square and variance of a continuous random variable. **07**

If quantization error is a random variable in PCM, and if signal amplitude range is from $-m_p$ to m_p which is divided into L equal intervals, determine the mean and mean square value of quantization error using statistical definitions.

(b) Derive the expression for marginal probability $P_x(x_i)$ and $P_y(y_j)$ **.** **07**

A binary symmetric channel has an error probability *Pe*. The probability of transmitting 1 is *Q* and that of transmitting 0 is 1-*Q*. Determine the probability of receiving 1 and 0 at the receiver.

If the receiver detects an incoming digit as 1, what is the probability that the corresponding transmitted digit was:

(a) 1; (b) 0?.

OR

(b) A binary source produces 0's and 1's independently with probabilities *P*(0)=0.2 and *P*(1)=0.8. The binary data is then transmitted over a noisy channel. The probability of correct reception when a '0' has been transmitted is 0.9 and the probability of erroneous reception when '1' has been transmitted is 0.2. **07**

(a) Find the probabilities of erroneous reception when a '0' is transmitted and probability of correct reception when a '1' was transmitted.

(b) Find the over all probability of receiving a '0' and a '1'.

(c) If a '1' is received, what is the probability that a '0' was transmitted.

Q.3 **(a)** Define the entropy of a discrete memoryless source emitting M symbols and discuss the properties of entropy. **07**

A zero memory source emits messages m_1 and m_2 with probabilities 0.8 and 0.2, respectively. Find the optimum binary compact code for this source and its second order extension. Determine code efficiencies in each case

(b) Explain Mutual information in detail. State its properties. **07**

OR

Q.3 **(a)** Explain delta modulation in detail. Also discuss advantages and disadvantages of delta modulation. **07**

(b) Describe the procedure for encoding and decoding of linear block code. **07**

Q.4 **(a)** For the data stream 10111001 draw the following formats. **07**

i) Polar NRZ ii) Split phase manchester iv) AMI NRZ

Discuss the desirable properties for selection of line codes.

(b) Show that the PSD of polar code is given by $Sy(f) = \frac{Tb}{4}\sin c^2\left(\frac{\pi fTb}{2}\right)$. Also draw and discuss the spectrum. **07**

OR

Q.4 **(a)** Derive Hamming Bound for (*n*,k) binary t-error correcting block code, where *n*=length of code word and *k*=length of data word (n>k). Define perfect code and Hamming codes. **07**

Q.4 **(b)** For a (6,3) systematic linear block code, the three parity check digits are **07**

c4 = d1+d2+d3, c5 = d1+d2, c5 = d1+d3

i) Construct the appropriate generator matrix for this code and code table. Determine the error correcting capability.

iii) Decode the received words 101100, 000110, 101010.

Q.5 **(a)** Explain mathematical and graphical representation of BPSK. Explain BPSK generation. **07**

(b) Explain QPSK with waveforms, constellation diagram and mathematical representation. **07**

OR

Q.5 **(a)** Derive expressions for impulse response and probability of error of Matched filter. **07**

(b) 1. Construct the systematic (7,4) cyclic code using the generator polynomial $g(x)=x^3+x+1$ **07**

2. What are the error correcting capabilities of this code?
3. Construct the decoding table.
4. If the received word is **1101100**, determine the transmitted data word.

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