Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VI• EXAMINATION–SUMMER 2015

Subject Code: 161001 **Date:01/05/2015**

Subject Name: Digital Communication

Time:10:30 am to 01:00 pm **Total Marks: 70**

Instructions:

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

Q.1 **(a)** Discuss channel capacity of a discrete memoriless channel with an arbitrary number of inputs. **07**

(b) Answer the following questions: (3+2+2 Marks) **07**

1 Justify "For finite signal and noise powers, the channel capacity always remains finite"

2 A random experiment consists of drawing two cards from a deck in succession (without replacing the first card drawn). Assign a value to the probability of obtaining two red aces in two draws.

3 Show that if two random variables are independent then they are uncorrelated.

Q.2 **(a)** Illustrate the problems of delta modulation with necessary waveforms. Explain how adaptive delta modulation corrects these problems. **07**

(b) The Rayleigh density is characterized by the PDF **07**

$$p_r(r) = \begin{cases} \frac{r}{\sigma^2} e^{-r^2} / 2\sigma^2 & r \geq 0 \\ 0 & r < 0 \end{cases}$$

Show that Rayleigh random variable can be derived from two independent Gaussian random variables.

OR

(b) A source emits seven messages with probabilities 1/3, 1/3, 1/9, 1/9, 1/27, 1/27, and 1/27, respectively. **07**

1. Obtain the compact 3-ary code and find code efficiency of the code
2. Obtain the compact binary code.

Q.3 **(a)** Explain Probability Density Function (PDF) of random variable with its properties. The PDF of amplitude x of a certain signal x(t) is given by $p_x(x) = 0.5|x|e^{-|x|}$. **07**

1. Find the probability that $-1 < x \leq 2$.
2. Determine mean and the variance of the RV x.

(b) Answer the following questions: (4+3 Marks) **07**

1 A signal m(t) of bandwidth B=4kHz is transmitted using a binary companded PCM with μ=100. Compare the cases of L=16 & L=128 from the point of view of transmission bandwidth and the output SNR.

2 Describe quantization noise in a PCM.

OR

Q.3 **(a)** For a (6,2) linear block code, the generator matrix G is **07**

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

1. Construct the code table for this code and determine the minimum distance between code-words.
2. Prepare a suitable decoding table.

(b) Answer the following questions: (4+3 Marks) **07**

1 Using general expression for finding Power Spectral Density (PSD), find PSD of an on-off signaling.

2 Draw the schematic of a regenerative repeater.

Q.4 **(a)** Explain the method proposed by Nyquist to resolve the difficulty of ISI using duobinary pulse. **07**

(b) Answer the following questions: (5+2 Marks) **07**

1 Draw a code tree for the convolutional coder having:
Constraint length = 3, $v_1 = s_1+s_2+s_3$ & $v_2 = s_1+s_3$.
Where $s_i = i^{th}$ stage of shift register and $v_i = i^{th}$ modulo-2 adder output.

2 What is Noise figure?

OR

Q.4 **(a)** Describe digital signal transmission using Quadrature Amplitude Modulation (QAM) using necessary diagram. **07**

(b) Answer the following questions: (4+3 Marks) **07**

1 Explain an M-ary FSK digital modulation technique in brief.

2 Explain method of generating systematic cyclic codes.

Q.5 **(a)** What is advantage of Differential Phase-Shift Keying (DPSK) over BPSK? Explain DPSK modulation technique in detail. **07**

(b) Derive the general expression of bit error rate for Optimum Binary Receiver. **07**

OR

Q.5 **(a)** What is the difference between coherent and non-coherent detection techniques? Describe non-coherent detection of FSK signal. **07**

(b) Describe frequency hopping spread spectrum (FHSS) system in detail. **07**

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