Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – WINTER 2018

Subject Code:2161001 Date:16/11/2018

Subject Name:Digital Communication

Time: 02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

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

			MARKS
Q.1	**(a)**	What is conditional probability? Explain it with suitable example.	**03**
	(b)	Compare Polar, On-off and Bipolar signalling with respect to desirable properties of line codes.	**04**
	(c)	State and prove sampling theorem in time domain. Explain aliasing and Nyquist rate.	**07**
Q.2	**(a)**	State the Shannon's theorem of channel capacity. What is its importance?	**03**
	(b)	Explain the difference between source coding and channel Coding.	**04**
	(c)	A source emits three equi-probable messages randomly and independently. i. Find the source entropy. ii. Find a compact ternary code, the average length of the code word, the code efficiency and the redundancy. iii. Repeat part (ii) for binary code. iv. To improve the efficiency of a binary code, we now the code the second extension of the source. Find a compact binary code, the average length of the code word, the code efficiency and the redundancy.	**07**
		OR	
	(c)	A source emits one of four messages randomly every 1 microsecond. The probabilities of these messages 0.5, 0.3, 0.1, 0.1. Messages are generated independently. i. Find the source entropy. ii. Obtain compact binary code and determine the average length of the code word, the code efficiency and the redundancy of the code. iii. Repeat part (ii) for compact ternary code.	**07**
Q.3	**(a)**	Explain the frame structure of T1 system in brief.	**03**
	(b)	The random variable X have uniform distribution as, $f_X(x) = \begin{cases} k(1-x^2) & 0 \le x \le 1 \\ 0 & \text{otherwise} \end{cases}$ Then find : (i) k (ii) CDF (iii) P ($0 \le x < 2$)	**04**
	(c)	Explain Delta modulation and demodulation technique and list the merits and demerits of this technique.	**07**
		OR	
Q.3	**(a)**	Draw the block diagram of regenerative repeater and briefly explain the function of each block.	**03**
	(b)	A random variable X has PDF : $f_X(x) = \begin{cases} 6x-6x^2 & 0 \le x \le 1 \\ 0 & \text{otherwise} \end{cases}$ Find constant b such that: P ($X \le b$) = P ($X > b$), Where b is constant $0 \le b \le 1$.	**04**

(c) A television signal (video and audio) has a bandwidth of 4.5 MHz. This signal is sampled, quantized and binary coded to obtain a PCM signal. **07**

i. Determine the sampling rate if the signal is to be sampled at a rate 20% above the Nyquist rate.

ii. If the samples are quantized into 1024 levels, determine the number of binary pulse required to encode each sample.

iii. Determine the binary pulse rate (bits per second) of binary coded signal and the minimum bandwidth required to transmit the signal.

Q.4 **(a)** Define the terms Mean, Central moment and Variance of a Random Variable. **03**

(b) Derive the formula for signal to quantization noise ratio for PCM. **04**

(c) Explain coherent detection of Frequency-Shift keying (FSK) signal with necessary equations. **07**

OR

Q.4 **(a)** What are the types of random variables? Explain them. **03**

(b) Explain the concept of scrambling. **04**

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

Q.5 **(a)** What is Burst error? Explain Burst error correction. **03**

(b) Explain the Convolution code with suitable example. **04**

(c) For a systematic linear block code, the three parity check digits, **07**

C_4, C_5 and C_6 are given by:

$C_4 = d_1 \oplus d_2 \oplus d_3$

$C_5 = d_1 \oplus d_2$

$C_6 = d_1 \oplus d_3$

i. Construct generator matrix.

ii. Construct code generated by this matrix.

iii. Determine error correcting capability.

iv. Prepare a suitable decoding table.

v. Decode the received words 101100,000110 and 101010.

OR

Q.5 **(a)** Define the following terms **03**

i. Hamming distance

ii. Code rate

iii. Weight of code

(b) Explain Cyclic code with suitable example. **04**

(c) A binary channel matrix is given by : **07**

$$\begin{array}{c} \\ \text{inputs} \rightarrow \end{array} \begin{array}{c} \begin{array}{cc} y1 & y2 \end{array} \rightarrow \text{outputs} \\ \begin{array}{c} x1 \\ x2 \end{array} \begin{bmatrix} 2/3 & 1/3 \\ 1/10 & 9/10 \end{bmatrix} \end{array}$$

$p(x_1) = 1/3$ and $p(x_2) = 2/3$ Determine H (X), H (X/Y), H (Y/X) and mutual information I (X ; Y)

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