Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2020

Subject Code:2161001 **Date:20/01/2021**

Subject Name:Digital Communication

Time:02:00 PM TO 04:00 PM **Total Marks: 56**

Instructions:

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

Q.1	**(a)**	Derive Bay's rule.	**03**
	(b)	Five telemetry signals, each of bandwidth 1kHz, are to be transmitted simultaneously by binary PCM. The maximum tolerable error in sample amplitudes is 0.2% of the peak signal amplitude. The signal must be sampled at least 20% above the Nyquist rate. Framing and synchronizing requires an additional 0.5% extra bits. Determine the minimum possible data rate (bits per second) that must be transmitted and minimum bandwidth required to transmit this signal.	**04**
	(c)	Explain Quantization noise in a PCM. For a PCM signal, determine L if the compression parameter μ=100 and the minimum SNR required is 45 dB.	**07**
Q.2	**(a)**	Describe "Timing Extraction" required to sample incoming pulses at precise instants in regenerative repeater.	**03**
	(b)	Explain an M-ary FSK digital modulation technique in brief.	**04**
	(c)	Explain the operation of Delta Modulation using block diagram and waveforms. Discuss the need of Adaptive Delta Modulation.	**07**
Q.3	**(a)**	Compare the On-off and Bipolar signaling for transmission of digital data.	**03**
	(b)	Using general expression for finding Power Spectral Density (PSD), find PSD of a polar signaling.	**04**
	(c)	Explain Differential Phase-Shift Keying (DPSK) modulation technique in detail. What is advantage of DPSK over Binary-Phase Shift Keying (BPSK)?	**07**
Q.4	**(a)**	Explain Noise temperature and Noise figure in brief.	**03**
	(b)	Compare QPSK and MSK modulation techniques.	**04**
	(c)	Describe non-coherent detection of Amplitude-Shift Keying (ASK) signal.	**07**
Q.5	**(a)**	We have two boxes. Box-1 contains 1000 components of which 5% are defective. Box-2 contains 200 components of which 20% are defective. We select at random one of the boxes and we remove at random a single component then, what is the probability that the selected component is defective?	**03**
	(b)	Explain coherent detection of Frequency-Shift keying (FSK) signal.	**04**
	(c)	A zero-memory source emits six messages with probabilities 0.4, 0.2, 0.1, 0.1, 0.1, and 0.1. Find binary Huffman code and determine the code efficiency of the code.	**07**

Q.6 **(a)** Determine mean and the variance of the RV x whose PDF is given by $p_x(x) = 0.5|x|e^{-|x|}$. **03**

(b) Explain Chebyshev's Inequality. **04**

(c) For a (7,4) linear block code, the generator matrix G is **07**

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

1. Construct the code table generated by this matrix.
2. Prepare a suitable decoding table.

Q.7 **(a)** Explain Interlaced code for burst error correction. **03**

(b) Explain code tree for Convolutional codes with suitable example. **04**

(c) Explain Cumulative Distribution Function (CDF) and Probability Density Function (PDF) of random variable in detail. **07**

Q.8 **(a)** Show that for finite signal and noise powers, the channel capacity always remains finite in the case of AWGN channel. **03**

(b) Explain syndrome decoding of systematic cyclic codes. **04**

(c) Derive expression for channel capacity of discrete memory-less channel with an arbitrary number of inputs. **07**

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