GUJARAT TECHNOLOGICAL UNIVERSITY ME – SEMESTER-1 (OLD) EXAMINATION – WINTER 2016

Subject Code: 710203N Date:19/11/2016 **Subject Name: Information Theory and Coding** Time:10:30 am to 1:00 pm **Total Marks: 70** Instructions: 1. Attempt all questions. 2. Make suitable assumptions wherever necessary. 3. Figures to the right indicate full marks. 0.1 (a) Consider an experiment of drawing two cards from a deck of cards without 07 replacing the first card drawn. Determine the probability of obtaining two red aces in two draws. (b) Explain cross-correlation of two random processes and its significance in 07 information theory and coding. **O.2** (a) Discuss Gaussian distribution function and state central limit theorem. 07 The PDF of a random variable X is p(x). A random variable Y is define as 07 **(b)** Y = a X + b, Where a < 0. Determine the PDF of Y in terms of the PDF of X. OR Explain the procedure to determine the relation between two different WSS **(b)** 07 random processes correlated with each other. Q.3 An analog signal having 3kHz bandwidth is sampled at 1.5 times the Nyquist 07 (a) rate. The successive samples are statistically independent. Each sample is quantized into one of the 256 equally likely levels (i) Find the information rate of the source (ii) Find the SNR required for error free transmission with a bandwidth of 10kHz and SNR of 20dB. (b) What are convolution codes? Explain encoding and decoding for convolutional 07 codes. OR 0.3 A DMS X has five symbols x_1, x_2, \dots, x_5 with $P(x_1)=0.4, P(x_2)=0.17$, 07 **(a)** P(x3)=0.18, P(x4)=0.1 and P(x5)=0.15, respectively (i) Construct a Shannon-Fano code for X (ii) Calculate the efficiency of the code (b) Explain Kraft's inequality and its significance in coding. 07 **(a)** With a suitable example explain arithmetic coding. What are the advantages of **O.4** 07 arithmetic coding scheme over Huffman coding? **(b)** What is hamming distance? Give the criteria for error detection and error 07 correction capabilities of a code, respectively. OR Consider a (5,1) linear block code defined by the generator matrix 07 **Q.4 (a)** $G = [1 \ 1 \ 1 \ 1 \ 1]$ Find the parity-check matrix H of the code in systematic form. (i) Find the decoding table for the linear block code (consider single bit (ii) errors only).

(b) Determine the parity-check matrix H for the (5,3) code. Show that $G.H^{T}=0$ and **07** v. $H^{T}=0$ for v= (1 1 0 1 0)

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$$\mathbf{G} = \left(\begin{matrix} 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ & & & & & \end{matrix} \right)$$

- Q.5 (a) Explain MPEG-1 standard giving the details of audio and video compression 07 techniques applied.
 - (b) What do you mean by symmetric key and asymmetric-key cryptography? What 07 is 'man-in-the-middle' attack?

OR

- Q.5 (a) Explain CCITT group 3 and group 4 encoding schemes for 1D and 2D 07 compression.
 - (b) What do you understand by digital signature? Discuss its application in 07 authentication of documents.
