Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –Ist SEMESTER–EXAMINATION – JULY- 2012

Subject code: 710203N **Date: 09/07/2012**

Subject Name: Information Theory and Coding

Time: 2:30 pm – 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.**

Q.1	**(a)**	Explain cross-correlation of two random processes and its significance in information theory and coding.	**07**
	(b)	If Random Variables X and Y are statistically independent and jointly Gaussian distributed with zero mean and equal variance. Derive the expression for their joint and individual PDFs.	**07**
Q.2	**(a)**	Discuss Gaussian distribution function and state central limit theorem.	**07**
	(b)	The PDF of a random variable X is p(x). A random variable Y is define as Y = a X +b, Where a < 0. Determine the PDF of Y in terms of the PDF of X.	**07**
		OR	
	(b)	Consider an experiment which consists of rolling of two dice. Find the CDF for the random variable X if it assigns the sum of numbers appearing on the dice to each outcome.	**07**
Q.3	**(a)**	Discuss Rayleigh distribution function.	**07**
	(b)	Write a short note on video compression	**07**
		OR	
Q.3	**(a)**	Explain how Huffman coding is used in Text coding and audio compression?	**07**
	(b)	A code is composed of dots and dashes. Assuming that a dash is 3 times as long as dot and has 1/3 the probability of occurrence. Calculate (i) The information in dot and a dash. (ii) The entropy of dot-dash code. (iii)The average rate of information if a dot lasts for 10 msec and this time is allowed between symbols.	**07**
Q.4	**(a)**	Explain how the spectral density of a WSS (wide sense stationary) random process can be estimated.	**07**
	(b)	A source emits an independent sequence of symbols from an alphabet consisting of five symbols A, B,C,D and E with probabilities of 1/4,1/8,1/8,3/16,and 5/16 respectively. Find the Shannon code for each symbol and efficiency of the coding scheme.	**07**
		OR	
Q.4	**(a)**	State and explain Shannon's Hartley law. Derive the expression for the upper limit of the channel capacity. Discuss the tradeoff between S/N ratio and bandwidth.	**07**

(b) Given the messages s_1, s_2, s_3 and s_4 with respective probabilities of 0.4, 0.3, 0.2 and 0.1, construct a binary code by applying Huffman encoding procedure. Determine the efficiency and redundancy of the code so formed. **07**

Q.5 **(a)** Explain Arithmatic code in detail with example. **07**

(b) The generator polynomial for a (15,7) cyclic code is **07**

$g(X) = 1+X^4 +X^6+X^7+X^8$

(i) Find the code vector in systematic form for the message $D(X) = X^2+X^3+X^4$

(ii) Assume that the first and the last bit of the code vector V (X) for $D(x) = X^2+X^3+X^4$ suffers transmission errors. Find the syndrome of V(X)

OR

Q.5 **(a)** Discuss public key and private key algorithm in detail. **07**

(b) Consider a (6,3) linear block code with the parity check matrix H given by **07**

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

(i) Find the generator matrix G.

(ii) Find the code word for the data bit 101.

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