Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Regular Examination January / February 2011

Subject code: 710203N

Subject name: Information Theory and Coding

Date: 02 /02 /2011 **Time: 02.30 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 the properties of PDF (probability density function) and CDF (cumulative distribution function) of random variables. **06**

(b) A fair dice with six faces rolled once. Plot the PDF and CDF for this experiment. **04**

(c) In an experiment the space S = {1, 2, 4} such that P(1)=0.3 and P(2)=0.2. Plot the PDF and CDF for the same. **04**

Q.2 **(a)** Determine the value of the unknown 'k' in the expression **07**

$$f(x) = x, \text{ if } 0 < x \leq k.$$

Such that f(x) can be considered as a valid PDF and plot both f(x) and the corresponding CDF in this case.

(b) Explain Poisson distributed discrete random variable giving an expression of the corresponding PDF and determine the mean and variance for the same. **07**

OR

(b) Explain Gaussian RV (random variable) with zero mean and unit variance giving an expression of the corresponding PDF. Explain the effects of adding a constant 'a' to this Gaussian RV and multiplying this Gaussian RV by another constant 'b', respectively, with the help of sketches of the corresponding PDFs. **07**

Q.3 **(a)** Define characteristic function for a DRV (discrete random variable) and explain its application for determining moments of the DRV with an example of binomial DRV. **07**

(b) Explain the fundamental theorem for determining the PDF of a function of single random variable. **07**

OR

Q.3 **(a)** Define ACF (auto-correlation function) for random processes and explain its main properties. **07**

(b) Explain how the spectral density of a WSS (wide sense stationary) random process can be estimated. **07**

Q.4 **(a)** Explain linear filtering of a white process. Estimate the filter impulse response if the output of the filter is observable. **07**

(b) Explain the concepts of uncertainty, information, and entropy. **03**

(c) Explain how the information of a discrete message is measured. Define various units of the information measure giving inter-relation between any two of them. **04**

OR

Q.4 **(a)** State and prove the condition for the maximum entropy for a binary source. Sketch the entropy versus probability of a symbol depicting the extreme points. **07**

	(b)	A source emits five messages with probabilities 1/2, 1/4, 1/8, 1/16, and 1/16, respectively. Determine the entropy of the source and obtain a compact binary code for the same.	**07**
Q.5	**(a)**	What is Hamming distance? Give the criteria for error detection and error correction capabilities of a code, respectively.	**07**
	(b)	Explain a (7, 4) linear block code with its generator matrix and its dual code.	**07**

OR

Q.5	**(a)**	Explain (7, 4) cyclic code giving its generator polynomial and give the corresponding code words for at least four different data vectors.	**07**
	(b)	Explain various functional blocks of JPEG - image compression standard.	**07**

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