Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– II(New course) • EXAMINATION (Remedial) – WINTER- 2015

Subject Code: 2720501 **Date: 08/12/2015**

Subject Name: Statistical Signal Analysis

Time:2:30 pm to 5:00 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)** What is significance of Cumulative Distribution Function (CDF)? Show that Cumulative Distribution function (CDF) of random variable is non-decreasing function. **07**

(b) (i)A fair coin is tossed repeatedly until the first heads shows up; the outcome of the experiment is the number of tosses required until the first heads occurs. Find the probability law for this experiment. **04**

(ii) Define conditional probability and explain with example **03**

Q.2 **(a)** (1) Two numbers x and y are selected at random between zero and one. Let the events A, B and C are defined as follows: **04**

$A=\{x > 0.5\}$, $B=\{y > 0.5\}$, and $C = \{x > y\}$.

Are the events A and B are independent? Are the events A and C are independent?

(2) State and explain conditions of events A and B to be statistically independent. **03**

(b) All manufactured devices and machines fail to work sooner or later. Suppose that the failure rate is constant and the time to failure (in hours) is an exponential random variable X with parameter λ. **07**

(a) Measurements show that the probability that the time to failure for computer memory chips in a given class exceeds lo4 hours is e^{-1}. Calculate the value of the parameter λ.

(b) Using the value of the parameter λ determined in part (a), calculate the time x_0, such that the probability that the time to failure is less than x, is 0.05.

OR

(b) Let X be a binomial random variable with parameters (n, p). Find the mean and variance of the same **07**

Q.3 **(a)** Show that the poisson distribution can be used as a convenient approximation to the binomial distribution for large n and small p **07**

(b) What is Chebyshaveôs inequality? Where it is used? Write short note on it. **07**

OR

Q.3 **(a)** Define and explain Mean Square Derivative of random process X(t) **07**

(b) Let X be a continuous random variable with the pdf **07**

$$f_X(x) = \begin{cases} e^{-x} & x > 0 \\ 0 & x < 0 \end{cases}$$

Find the transformation Y = g(X) such that the pdf of Y is

$$f_Y(y) = \begin{cases} \frac{1}{2\sqrt{y}} & 0 < y < 1 \\ 0 & \text{otherwise} \end{cases}$$

Q.4 **(a)** State and prove Central limit theorem. **07**

(b) Explain Joint Moments, Correlation, and Covariance. Also prove that covariance of independent random variable is zero. **07**

OR

Q.4	**(a)**	Define and explain Ergodic process. Explain concept of ensemble average and time average.	**07**
	(b)	Consider two random variables X and Y with joint pdf $f_{xy}(x, y)$. Let $Z = X + Y$. (a) Determine the pdf of Z. (b) Determine the pdf of Z if X and Y are independent.	**07**
Q.5	**(a)**	Consider an experiment of drawing randomly three balls from an urn containing two red, three white and four blue balls. Let (X, Y) be a random variable, where X and Y denotes respectively the number of red and white balls chosen, Find range of (X,Y), joint pmfôs of (X,Y), marginal pmfôs of X and Y. Are X and Y independent?	**07**
	(b)	Explain Mean Square Continuity in context of random process	**07**

OR

Q.5	**(a)**	Derive Power Spectral Density of output when random process x(t) passes through LTI system having impulse response $h(t)$	**07**
	(b)	Show that a WSS random process $X(t)$ is mean square continuous if and only if its autocorrelation function $R_x(\tau)$ is continuous at $\tau = 0$.	**07**

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