

GUJARAT TECHNOLOGICAL UNIVERSITY
ME – SEMESTER I (OLD) – • EXAMINATION – SUMMER 2016

Subject Code: 710401N**Date: 16/05/2016****Subject Name: Statistical Signal Analysis****Time: 02:30 pm to 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)** What is significance of Cumulative Distribution Function (CDF), State and prove properties of CDF. **07**
- (b)** A lot of 100 semiconductor chips contain 20 that are defective. Two chips are selected at random, without replacement, from the lot. **07**
- (a)** What is the probability that the first one selected is defective?
- (b)** What is the probability that the second one selected is defective given that the first one was defective?
- (c)** What is the probability that both are defective?
- Q.2 (a)** State and explain Markov and Chebyshev's inequalities. **07**
- (b)** A uniformly distributed Random variable X has Probability Density Function (PDF) $f_X(x) = 1/2\pi$, $0 \leq X \leq 2\pi$. Find $E[\cos(x)]$ and $E[x^2]$. **07**
- OR**
- (b)** Find the normalization constant c and the marginal PDF's for the following joint PDF :
- $$f_{X,Y}(x,y) = ce^{-x}e^{-y}, 0 \leq y \leq x \leq \infty$$
- = 0, elsewhere
- Also, Find $P[X + Y \leq 1]$. **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)** Let the random variable Y be defined by $Y = aX + b$, Where a is a nonzero constant. Suppose that X has CDF $F_X(x)$, then find $F_Y(y)$ and $f_Y(y)$. **07**
- OR**
- Q.3 (a)** Explain the central limit theorem with proper example. **07**
- (b)** Let $Y = a \cos(\omega t + \phi)$ where a, ω and t are constants and ϕ is a uniform random variable in the interval $(0, 2\pi)$. The random variable Y results from sampling the amplitude of a sinusoid with random phase ϕ . Find the expected value of Y and expected value of the power of Y, Y^2 . **07**
- Q.4 (a)** For random process define cross correlation function and cross power spectral density. Give useful property of cross power spectral density. **07**
- (b)** If X and Y both are independent then show that $E[XY] = E[X] E[Y]$. **07**
- OR**
- Q.4 (a)** What is Ergodic random process? With an example explain it in detail. **07**
- (b)** Find the characteristic function of the uniform random variable in the interval [a, b]. Find the mean and variance of X by applying the moment theorem. **07**
- Q.5 (a)** Define Almost sure convergence, Mean square sense convergence. **07**
- (b)** Consider a random process X(t) given by **07**
- $$X(t) = A \cos(wt + \theta)$$
- where w and A are constant and θ is a uniform random variable over $(-\pi, \pi)$. Determine whether X(t) is Wide sense random process or not.

OR

- Q.5** (a) What is a random process? Give classification of random processes with proper examples. **07**
- (b) Consider a random amplitude sinusoid signal with period T, **07**
 $X(t) = A \cos(2\pi t/T)$
Is $X(t)$ cyclostationary ? Wide sense cyclostationary ?
