Code No. 5420 / N

FACULTY OF ENGINEERING

B.E. 2/4 (ECE) II - Semester (New) (Main) Examination, May 2016

Subject : Probability Theory and Stochastic Processes

Time : 3 hours **Max. Marks : 75**

Note: Answer all questions from Part-A. Answer any FIVE questions from Part-B.

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PART – A (25 Marks)

1 State the fundamental Axioms of Probability. 3

2 State Bernoulli's theorem. 2

3 Define Cumulative Distribution Function (CDF) and state its properties. 3

4 A pair of dice is rolled. Find the probability of an event A defined as A = {sum of two dice = 7}. 3

5 What is a Gaussian Random variable? 2

6 If X is a discrete random variable, define the expectation of the random variable and the variance of the random variable. 3

7 Define the moment generating function of a continuous random variable X. 2

8 State the Central Limit theorem. 2

9 Define Autocorrelation function of a random process and state its properties. 3

10 Define White Noise. 2

PART – B (50 Marks)

11 a) State and prove the theorem of Total Probability. 5

b) Manufacturer X produces personal computers (PCs) at two different locations in the world. Fifteen percent of PCs produced at location A are delivered defective to a retail outlet, while 5 percent of PCs produced at location B are delivered defective to the same retail store. If the manufacturing plant at A produces 1,00,000 PCs per year and the plant at B produces 1,50,000 PCs per year, find the probability of purchasing a defective PC. 5

12 a) Define probability density function (PDF) and state its properties. 4

b) Determine the real constant 'a' for arbitrary real constants m and b > 0, such that $f_X(x) = a\ e^{-|x-m|/b}$ is a valid density function. 6

13 Let X be a Gaussian random variable with zero mean and variance σ^2. If $Y = X^2$ is the transformation. Find the new density function $f_Y(y)$. 10

14 a) If X has the probability density function $f_X(x) = \begin{cases} e^{-x} & x > 0 \\ 0 & \text{elsewhere} \end{cases}$ find the $E\left[e^{\frac{3x}{4}}\right]$. 5

b) Find the density function of a random variable whose characteristic function is given by $\phi_X(\omega) = \frac{1}{2}e^{-|\omega|}\ -\infty \le \omega \le \infty$. 5

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15 a) Define joint density function $f_{XY}(x, y)$ and write down the expression for getting the marginal density functions of X and Y using the joint density function $f_{XY}(x, y)$. 4

b) Suppose the random variables X and Y have a joint pdf given by $f_{XY}(x,y) = \begin{cases} 1 & 0 \le x, y \le 1 \\ 0 & \text{otherwise} \end{cases}$ Find the marginal pdfs $f_X(x)$ and $f_Y(y)$ and check whether the random X and Y are statistically independent. 6

16 Suppose X and Y are statistically independent random variables, having PDFs given by $f_X(x) = a\exp(-ax)u(x)$ and $f_Y(y) = b\exp(-by)u(y)$ then find the PDF of a new random variable given by $Z = X+Y$. 10

17 Consider a random process $X(t) = a\cos(w_0 t + \theta)$ where θ is a uniform random variable in the interval $[0, 2\pi)$.

a) Check whether the random process is wide sense stationary. 5

b) Check whether the random process is ergodic in mean and autocorrelation. 5

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