**Code No. 5114 / O**

# FACULTY OF INFORMATICS

**B.E. 2/4 (IT) II - Semester (Old) Examination, May 2016**

**Subject : Probability and Random Processes**

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

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

## PART – A (25 Marks)

1 Compare Axiomatic, relative frequency and classical definitions of probability. 3

2 If A and B are events, when is P(AB) = P(A) P(B) true? 2

3 State the conditions under which the following statement about random Poisson points hold true :

$$P\{K \text{ in } t_a\} = \overline{e}^{\lambda ta} \cdot \frac{({}^{a}t_a)^k}{k!}$$

where P{k in $t_a$} is the probability that k of the points are in a time interval of length $t_a$. 2

4 If voltage v is a random variable given by v = i (r +$r_0$), I = 0.01 A and $r_0$ = 1000 Ω. If the resistance r is a random variable uniform between 900 Ω and 1100 Ω. Is voltage a uniform random variable? If yes, find the interval in which it is uniform. 2

5 If x and y are independent exponential random variables with common parameter λ, and u = x+y, v = x-y. find the joing and marginal p.d.f. of u and v. 3

6 Show that the characteristic function of the convolution of two densities equals the product of their characteristic functions. 3

7 State properties of covariance function. 2

8 Show that mean of white noise process is equal to zero. 3

9 Show that if a process is normal and distribution-ergodic, then it is also mean-ergodic. 3

10 If x(t) is a WSS process with autocorrelation. 2

$$R({}^{2}) = A\,\overline{e}^{\alpha|{}^{2}|}$$

Find E{[x(8) – x(5)]$^2$}.



## PART – B (50 Marks)

11 a) State and prove Baye's theorem. 5

b) A pair of dice is rolled n times. Find the number of throws required to assure a 50% success of obtaining double six atleast once. 5

12 a) Explain how you conclude that 5

$$P\{k \text{ heads in any order}\} = \binom{n}{k} p^k\, q^{n-k}$$

b) Two players A and B agree to play a series of games on the condition that A wins the series if he succeeds in winning m games before B wins n games. The probability of winning a single game is p for A and q = 1-p for B. That is the probability that A will win the series. 5

13 a) If $f_x(x) = \begin{cases} a\ \bar{e}^{\lambda x} & x \geq 0 \\ 0 & \text{otherwise} \end{cases}$ 4

Find $F_x(x)$ and plot f(x) and F(x).

b) If $y = x^2$ is a function of random variable. Find 6

i) $F_y(y)$ for y > 0 and y < 0

ii) $f_y(y)$

If $f_x(x)$ represent an even function and x~N(0, 1),

Show that $f_y(y) = \frac{1}{\sqrt{2\text{®}y}}\ \bar{e}^{y/2} \cdot U(y)$

14 a) x and y are independent uniformly distributed random variables on (0, 1). Find the joint p.d.f. of x+y and x-y. 5

b) A fine needle of length 2a is dropped at random on a board covered with parallel lines distance 2b apart, where b>a. Show that the probability that the needle intersects one of the lines equals 2a/πb. 5

15 a) State Wiener-Khinchine theorem and explain how it can be used to show localization of the average power of x(t) on the frequency axis. 5

b) Find $S(w)$ if i) $R(\text{²}) = \bar{e}^{\sim\text{²}\,2}$ ii) $R(\text{²}) = \bar{e}^{\sim\text{²}\,2} \cdot \cos w_0\text{²}$ 5

16 a) If x(t) is a normal stationary process with zero mean, then show that the autocorrelation of the output of a hard limiter equals 5

$$R_y(\text{²}) = \frac{2}{\text{®}} \text{arc sin} \frac{R_x(\infty)}{R_x(0)}$$

b) x(t) is a SSS process and $\in$ is a random variable independent of x(t). Show that the process y(t) = x(1-$\in$) is SSS. 5

17 a) Define power spectrum of a WSS process. 3

b) A random telegraph signal is a process x(t) taking n values +1 and -1. 7

$$x(t) = \begin{cases} 1 & t_{2i} < t < t_{2i} + 1 \\ -1 & t_{2i-1} < t < t_{2i} \end{cases}$$

Where $t_i$ is a set of Poisson points with average density λ. Find S(w).

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