**Code: 20A54403**

**R20**

B.Tech II Year II Semester (R20) Regular & Supplementary Examinations April/May 2024

**PROBABILITY THEORY & STOCHASTIC PROCESSES**

(Electronics & Communication Engineering)

Time: 3 hours | Max. Marks: 70

**PART – A**

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

| | | |
|---|---|---|
| (a) | State the Baye's theorem of probability. | 2M |
| (b) | Define conditional density function and state the properties of it. | 2M |
| (c) | Differentiate between central moments and moments about the origin. | 2M |
| (d) | State the Central Limit Theorem. | 2M |
| (e) | Define moments about the origin for a random variable. | 2M |
| (f) | Write short notes on statistical independence for two random variables. | 2M |
| (g) | Define stationarity in the context of random processes. | 2M |
| (h) | Define Power Spectral Density of random process. | 2M |
| (i) | Write short notes on noise figure. | 2M |
| (j) | What is thermal noise? How is it quantified? | 2M |

**PART – B**

(Answer all the questions: 05 X 10 = 50 Marks)

2 (a) Discuss Joint and Conditional Probability. 5M

(b) When two dice are thrown, determine the probabilities from axiom 3 for the following events. 5M

(i) A= {Sum = 7},

(ii) B= { $8 \le Sum \le 17$ },

(iii) C= {10 < Sum },

(iv) $P(B \cap C)$,

(v) $P(B \cup C)$.

**OR**

3 (a) State and prove the Baye's theorem of probability. 5M

(b) A speaks truth in 75% and B in 80% of the cases. In what percentage of cases are they likely to contradict each other narrating the same incident? 5M

4 (a) Define Characteristic function? State and prove the properties of characteristic function. 5M

(b) The characteristic function for a random variable X is given by, $\Phi_X(\omega) = \frac{1}{(1 - j2\omega)^{\frac{N}{2}}}$. Find the mean and second moment of X. 5M

**OR**

5 If the random variable X has the MGF, $M_X(t) = \frac{2}{2-t}$. Determine the variance of X. 10M

6 (a) Define joint Pdf and State & prove the properties of joint probability density function. 5M

(b) Statistically independent random variables X and Y have moments $m_{10} = 2, m_{20} = 14,$ $m_{02} = 12$ and $m_{11} = -6$. Find the moment $\mu_{22}$. 5M

**OR**

**Contd. in Page 2**

7 Consider random variables $Y_1$ and $Y_2$ related to arbitrary random variables X and Y by the coordinate rotation, $Y_1 = XCos\theta + YSin\theta$ ; $Y_2 = -XSin\theta + YCos\theta$ . 10M

(i) Find the covariance of $Y_1$ and $Y_2$ ,

(ii) For what values of $\theta$ , the random variables $Y_1$ and $Y_2$ are uncorrelated.

8 Define auto correlation function of random process? State and prove the properties of ACF of random process. 10M

**OR**

9 State and prove the properties of Power spectral density of random process. 10M

10 Explain the following: 10M

(i) Extraterrestrial noise,

(ii) Short noise,

(iii) Thermal noise.

**OR**

11 Derive the expression for effective input noise temperature of cascaded system in terms of their individual input noise temperatures. 10M

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**Code: 20A54403** **R20**

B.TechII Year II Semester (R20) Regular &Supplementary Examinations August/September2023

**PROBABILITY THEORY & STOCHASTIC PROCESSES**

(Electronics & Communication Engineering)

Time: 3 hours Max. Marks: 70

**PART – A**

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

| | | |
|---|---|---|
| (a) | Define probability using the axiomatic approach. | 2M |
| (b) | What are the conditions for a function to be a random variable? | 2M |
| (c) | What are equal and unequal distributions? | 2M |
| (d) | Define moment generating function and write the formula to find mean and variance. | 2M |
| (e) | List the properties of Gaussian random variables. | 2M |
| (f) | Define Joint central movement. | 2M |
| (g) | What is random process? | 2M |
| (h) | Explain First order stationary process briefly. | 2M |
| (i) | Define autocorrelation function of response. | 2M |
| (j) | Define colored noise. | 2M |

**PART – B**

(Answer all the questions: 05 X 10 = 50 Marks)

2 (a) An experiment consists of observing the sum of the outcomes when two fair dice are thrown. Find the probability that the sum is 7 and find the probability that the sum is greater than 10. 5M

(b) In a factory there are 4 machines produce 10%,20%,30%,40% of items respectively. The defective items produced by each machine are 5%,4%,3% and 2% respectively. Now an item is selected which is to be defective, what is the probability it being from the 2nd machine? 5M

**OR**

3 (a) What is conditional distribution? What are the methods of defining conditioning event? 5M

(b) Describe different types of Random variables with examples. 5M

4 (a) Derive the Moment generating function About Origin. 5M

(b) Calculate mean, standard deviation, moment in each of the following alternative cases: 5M

(i) Number of trials are 18 and probability of success is 1/3,

(ii) Number of trials are 18 and probability of failure is 1/3.

**OR**

5 (a) State and explain the properties of joint density function. 5M

(b) The joint density function of random variables X and Y is; 5M

$(X, y)$ = { $8xy$; 0 ≤ $x$< 1, 0<$y$<1

0$therwise$x,y = 0.

Find f(y/x) and f(x/y).

**Contd. In Page 2**

| | | | |
|---|---|---|---|
| 6 | (a) | Write short notes on Gaussian distribution and also find its mean. | 5M |
| | (b) | Consider that a fair coin is tossed 3 times, Let X be a random variable, defined as X= number of tails appeared, find the expected value of X. | 5M |
| | | **OR** | |
| 7 | (a) | Explain about Linear transformations of Gaussian random variables. | 5M |
| | (b) | Explain point conditioning and interval conditioning. | 5M |
| 8 | | A random process has sample functions of the form $X(t)=A\cos(\omega t+\theta)$ where $\omega$ is constant, A is a random variable with mean zero and variance one and $\theta$is a random variable that is uniformly distributed between 0 and 2π. Assume that the random variables A and $\theta$ are independent. Is X(t) meanergodic-process? | 10M |
| | | **OR** | |
| 9 | | Explain about the following random process:<br>(i) Mean ergodic process,<br>(ii) Correlation ergodic process,<br>(iii) Gaussian random process. | 10M |
| 10 | | Derive the relationship between crosspower spectral density and cross correlation function. | 10M |
| | | **OR** | |
| 11 | | For a input output linear system(X(t),h(t),Y(t)),derive the cross correlation function $R_{XY}(\tau)$ and the output auto correlation function $R_{xx}(\tau)$. | 10M |

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