



III B.Tech I Sem Regular End Examination, December 2022

Probability Theory and Stochastic Processes

(ECE)

Time: 3 Hours.**Max. Marks: 70**

Note: 1. Question paper consists: Part-A and Part-B.

2. In Part - A, answer all questions which carries 20 marks.

3. In Part - B, answer any one question from each unit.

Each question carries 10 marks and may have a, b as sub questions.

PART- A**(10*2 Marks = 20 Marks)**

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|-------|---|----|-----|-----|
| 1. a) | Define independent events. Give an example. | 2M | C01 | BL1 |
| b) | Why mathematical modeling of experiments is carried out? | 2M | C01 | BL1 |
| c) | Define Skew of a random variable. | 2M | C02 | BL1 |
| d) | Write Chebyshev's inequality. | 2M | C02 | BL1 |
| e) | State central limit theorem for equal distributions case. | 2M | C03 | BL1 |
| f) | Write the relationship between covariance and correlation of two random variables. | 2M | C03 | BL1 |
| g) | When do you say a random process is Nth order stationary? | 2M | C04 | BL1 |
| h) | Define a random process. | 2M | C04 | BL1 |
| i) | Write any two properties of power density spectrum. | 2M | C05 | BL1 |
| j) | A random process has autocorrelation function $5\delta(t)$, find its power density spectrum. | 2M | C05 | BL3 |

PART- B**(10*5 Marks = 50 Marks)**

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|-----------|--|----|-----|-----|
| 2 a) | Two boxes A and B contain 80 and 160 light bulbs respectively. A and B have 10 and 5 defective bulbs respectively. | 5M | C01 | BL3 |
| i) | Suppose a box is selected at random and one bulb is picked out. What is the probability that it is defective? | | | |
| ii) | Suppose we test the bulb and it is found to be defective. What is the Probability that it came from A? | | | |
| b) | Classify random variables and explain with relevant examples. | 5M | C01 | BL2 |
| OR | | | | |
| 3 a) | Explain the terms experiment, trial, outcome, event, mutually exclusive events considering an example sample space. | 5M | C01 | BL4 |
| b) | A pair of fair dice is thrown, what is the probability that the sum of numbers appearing on the faces is 11 or more? | 5M | C01 | BL3 |

- 4 A random variable X is uniformly distributed on the interval $-4 < x < 12$. Another random variable is defined as $Y = e^{-X/4}$. Find $E(Y)$. 10M C02 BL3
- OR**
- 5 a) Given k is a constant and X is a random variable with pdf

$$f_X(x) = \begin{cases} cx & 0 < x < 1 \\ 0 & \text{else where} \end{cases}$$
Find the value of c and $P[1/2 < X < 3/4]$ 5M C02 BL3
- b) What is a moment generating function and represent how 2nd and 4th order moments can be generated using it. 5M C02 BL3
- 6 a) The joint pdf of random variables X and Y is given 5M C03 BL3

$$f_{X,Y}(x,y) = \begin{cases} \frac{xy}{9} & 0 < x < 2 \text{ and } 0 < y < 3 \\ 0 & , \text{ else} \end{cases}$$
Find marginal density of X and Y. Check whether X and Y are correlated or not.
- b) Write the properties of joint density function of random variables x and Y. 5M C03 BL1
- OR**
- a) Write short notes on Marginal densities and distributions. 5M C03 BL1
- 7 b) Write in detail about jointly Gaussian random variables for the case of two random variables. 5M C03 BL1
- 8 a) Check whether the random process $X(t) = 5 \cos(\omega_0 t + \theta)$ is WSS process or not, for 'A' and ω_0 being constant and θ uniformly distributed between $(0, \pi)$. 5M C04 BL3
- b) Explain the terms SSS process and Correlation ergodic process. 5M C04 BL4
- OR**
- 9 a) Write the properties of Autocorrelation function of a random process and prove any one of them. 5M C04 BL1
- b) Prove that random process $X(t) = A \cos(\omega_c t + \theta)$ is a wide sense stationary process if it is assumed that A, ω_c are constants and θ is uniformly distributed over interval $0 \leq \theta \leq 2\pi$. 5M C04 BL3
- 10 a) Derive the expression for CPSD of input and output of an LTI system. 5M C05 BL6
- b) Derive the relationship between cross power spectrum and cross correlation function. 5M C05 BL6
- OR**
- 11 Derive the expression for power density spectrum of a random process. 10M C05 BL6

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