# Mahindra University Hyderabad

École Centrale School of Engineering

Minor-2 Exam

Program: B. Tech. Branch: CM Year: II Semester: II

Subject: Stochastic Processes (MA2213)

Date: 19/04/2025 Start Time: 10:00 AM

Time Duration: 1.5 Hours Max. Marks: 20

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***Instructions:***

1) Answer all the questions.
2) All questions are self-explanatory; no clarification will be provided during the exam.

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Course outcomes (COs)

CO 1: Apply stochastic processes for modeling time-evolving random events.

CO 2: Understand the existence of different types of limits, continuity, differentiability, and integrability.

CO 3: Apply and analyze stochastic filtering techniques and signal processing applications.

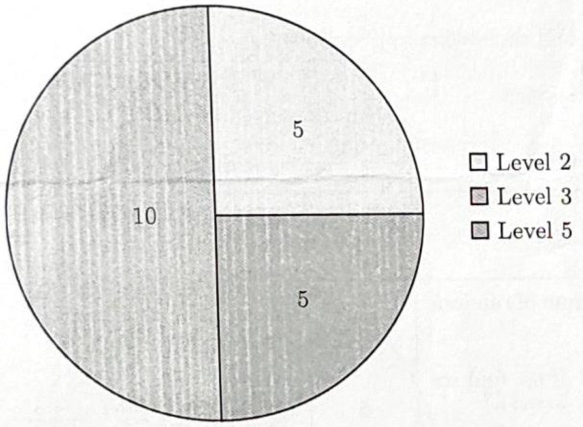
CO 4: Understand Markov processes and their applications.

| Q.No. | Questions | Marks | CO | BL | PO | PI Code |
|---|---|---|---|---|---|---|
| 1 | Let $R_X(\tau) = \sigma^2 e^{-\tau^2}$ be the autocorrelation function of random process $X(t)$.<br>(i) Does $X(t)$ have a mean square derivative? If so, find its mean and autocorrelation function.<br>(ii) Does $X(t)$ have a mean square integral? If so, find its mean and autocorrelation function. | 5 | CO2 | L2 | PO2 | 2.2.1 |
| 2 | A linear system with input $Z(t)$ is described by<br>$$X'(t) + \alpha X(t) = Z(t), \quad t \geq 0, \ X(0) = 0.$$<br>Find the output $X(t)$ if the input is a zero-mean Gaussian random process with autocorrelation function given by $R_X(\tau) = \sigma^2 e^{-2\|\tau\|}$. | 5 | CO2 | L3 | PO2 | 2.2.3 |

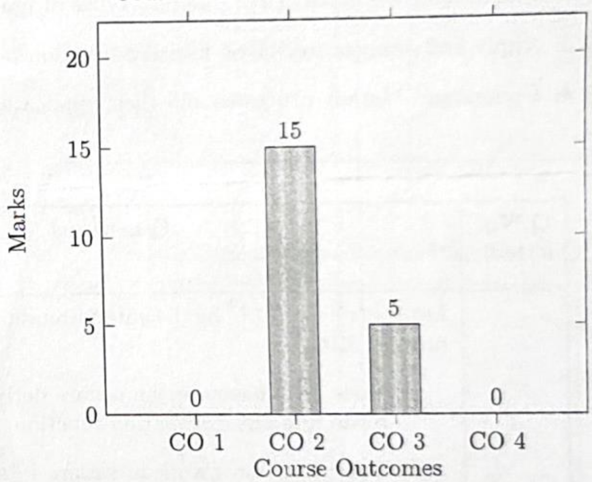
P.T.O.

| Q.No. | Questions | Marks | CO | BL | PO | PI Code |
|---|---|---|---|---|---|---|
| 3 | Let $X(t) = A\cos(2\pi\omega t)$, where $A$ is a random variable with mean $m$ and variance $\sigma^2$.<br>(i) Evaluate $\langle X(t)\rangle_T$, find its limit as $T \to \infty$, and compare with $m_X(t)$.<br>(ii) Evaluate $\langle X(t+\tau)X(t)\rangle_T$, find its limit as $T \to \infty$, and compare with $R_X(t+\tau, t)$. | 5 | CO2 | L5 | PO2 | 2.2.1 |
| 4 | Let $X(t)$ be a WSS Gaussian random process with $R_X(\tau) = e^{-\lvert\tau\rvert}$.<br>(i) Find the Fourier series expansion for $X(t)$ in the interval $[0, T]$.<br>(ii) Find the probability distribution of the coefficients in the Fourier series. | 5 | CO3 | L3 | PO2 | 2.3.2 |

Bloom's Level wise Marks Distribution




Course Outcome wise Marks Distribution




**BL – Bloom's Taxonomy Levels:**
1 – Remembering, 2 – Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 – Creating
**CO – Course Outcomes**
**PO – Program Outcomes**
**PI Code – Performance Indicator Code**

**End of exam**