Mahindra University Hyderabad
École Centrale School of Engineering
Minor-II Examinations, April-2023
Program: B. Tech. Branch: CM Year: II Semester: II
Subject: Stochastic Processes (MA2213)

Date: 03/05/2023 **Start Time: 10:00 AM**
Time Duration: 1.5 Hours **Max. Marks: 20**

Instructions:

1. All questions are compulsory.

Q 1:

Marks: 5

Let $R_X(\tau) = \sigma^2 e^{-\tau^2}$ be the autocorrelation function of random process $X(t)$.

(i) Does $X(t)$ have a mean square derivative? If so, find its mean and autocorrelation function.

(ii) Does $X(t)$ have a mean square integral? If so, find its mean and autocorrelation function.

Q 2:

Marks: 5

A linear system with input $Z(t)$ is described by

$$X'(t) + \alpha X(t) = Z(t), \quad t \geq 0, \; X(0) = 0.$$

Find the output $X(t)$ if the input is a zero-mean Gaussian random process with autocorrelation function given by $R_X(\tau) = \sigma^2 e^{-2|\tau|}$.

Q 3:

Marks: 5

Let $X(t) = A\cos(2\pi\omega t)$, where A is a random variable with mean m and variance σ^2.

(i) Evaluate $\langle X(t)\rangle_T$, find its limit as $T \to \infty$, and compare to $m_X(t)$.

(ii) Evaluate $\langle X(t+\tau)X(t)\rangle_T$, find its limit as $T \to \infty$, and compare to $R_X(t+\tau, t)$.

Q 4:

Marks: 5

Let $X(t)$ be a WSS Gaussian random process with $R_X(\tau) = e^{-|\tau|}$.

(i) Find the Fourier series expansion for $X(t)$ in the interval $[0, T]$.

(ii) Find the probability distribution of the coefficients in the Fourier series.