



SCHOOL OF ELECTRONICS ENGINEERING
CONTINUOUS ASSESSMENT TEST - II
WINTER SEMESTER 2025-2026

SLOT: AZ+TAZ

Programme Name & Branch : B. Tech - ECE
Course Code and Course Name : BECE207L – Random Processes
Faculty Name(s) : Dr. RAMACHANDRA REDDY; Dr. CHRISTOPHER CLEMENT J; Dr. KALAIVANI S; Dr. HARIHARAN S; Dr. ASHISH P; Dr. MUGELAN RK
Class Number(s) : VL2025260500725, 0729, 0731, 0737, 0738, 6507.
Date of Examination : 15-03-2026
Exam Duration : 90 minutes
Maximum Marks: 50

Answer All Questions

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

- **CO3:** Examine the temporal characteristics of random processes.
- **CO4:** Compute power spectral density of the random signals.

Q. No	Question	M	CO	BL
1.	Given a random variable Ω with density $f(\omega)$ and another random variable Φ uniformly distributed in $(-\pi, \pi)$ and independent of Ω . Prove that $X(t) = a \cos(\Omega t + \Phi)$ is a wide sense stationary process by utilizing the Law of Iterated Expectations (also known as the Tower Rule) : $E\{g(X, Y)\} = E[E\{g(X, Y)/X\}]$.	10	3	3
2 a)	A random process $X(t)$ is known to be Gaussian with autocorrelation function $R_{XX}(\tau) = 9 + 4e^{- \tau }$ i. Determine the mean and variance of the process $X(t)$. (2 marks) ii. Explain whether the samples $X(t)$ and $X(t + \tau)$ become independent as $\tau \rightarrow \infty$. Justify your answer using the properties of Gaussian random processes. (2 marks) iii. Briefly explain how the constant term in the autocorrelation function affects the mean of the process. (1 mark)	5	3	3
b)	A wireless base station receives packets according to a Poisson process with rate λ packets per second. i. If the average arrival rate doubles during peak hours, explain how the probability distribution of the number of arrivals in a fixed interval changes. (2 marks) ii. Two independent base stations receive packets according to Poisson processes with rates $\lambda_1 = 6$ packets/sec and $\lambda_2 = 4$ packets/sec. If their traffic streams are combined into a single server, determine the rate of the resulting process and justify your answer. (2 marks)	5	3	3



VIT

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iii. Explain why a Poisson process cannot be a stationary process, even though its increments are stationary. (1 mark)

3. Find the autocorrelation function from the power spectral density if

$$S_{XX}(\omega) = \frac{(\omega^2 + 1)}{(\omega^2 + 4)(\omega^2 + 9)}$$

Find the average power.

4. The cross spectral density (CSD) of two random processes $X(t)$ and $Y(t)$ is given by

$$S_{XY}(\omega) = \frac{1 + j\omega}{(j\omega)^2 + 5j\omega + 6}$$

Determine the cross-correlation function $R_{XY}(\tau)$.

A WSS random processes $X(t)$ has autocorrelation function $R_{XX}(\tau) = 2e^{-|\tau|}$ and is given as an input to a LTI system. If the cross-correlation of input and output process of the system is $R_{XY}(\tau) = 2e^{-|\tau|} - e^{-2\tau}u(\tau)$ then find the system transfer function and power spectral density of the output process $Y(t)$.

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