VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

REG.NO.:

SCHOOL OF ELECTRONICS ENGINEERING
CONTINUOUS ASSESSMENT TEST - II
WINTER SEMESTER 2024-2025

SLOT: A1+TA1

Programme Name & Branch	: B. Tech - ECE
Course Code and Course Name	: BECE207L – Random Processes
Faculty Name(s)	: Dr. RAMACHANDRA REDDY, Dr. MALAYA KUMAR HOTA Dr. HARIHARAN S, Dr. ASHISH P, Dr. MUGELAN R K
Class Number(s)	: 0631, 0642, 0646, 4700, 0654
Date of Examination	:16-03-2025
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:** Interpret the random processes in terms of stationarity, statistical independence, and correlation.
- **CO4:** Compute the power spectral density of the random signals.
- **CO5:** Interpret the effect of random signals on LTI systems output both in the time and frequency domain.

Q. No	Question	M	CO	BL
1.	Let $X(t)$ be a WSS process with auto correlation $R_{XX}(\tau) = e^{-a\|\tau\|}$, where $a > 0$ is a constant. Assume $Y(t) = X(t)\cos(\omega_0 t + \theta)$, where ω_0 is a constant and θ is uniformly distributed over the interval $(-\pi, \pi)$ and statistically independent of $X(t)$. Determine the autocorrelation function of $X(t)$.	10	3	3
2.	a) Compute the mean, mean square and variance of the random process $X(t)$ whose autocorrelation function is given by $R_{XX}(\tau) = 16 + \frac{2}{1+2\tau^2}$. b) $X(t)$ is a WSS process with autocorrelation function $R_{XX}(\tau) = 9 + e^{-2\|\tau\|}$. Determine a covariance matrix for the random variables $X(t), X(t+1)$ and $X(t+3)$.	10	3	3
3.	A WSS random process X(t) has a power spectral density $S_{XX}(\omega) = \begin{cases} 0.5(1+\cos\omega); & -\pi \le \omega \le \pi \\ 0; & otherwise \end{cases}$ i. Evaluate the function at $\omega = \pm\pi, \pm\frac{\pi}{2}, \pm\frac{\pi}{4}$ and 0, and sketch the spectrum. ii. Find the RMS bandwidth of $X(t)$.	10	4	3
4.	Let $X[n]$ and $Y[n]$ be statistically independent processes with autocorrelation functions $R_{XX}(k) = (0.5)^{\|k\|}$ and $R_{YY}(k) = 2\delta(k) + \cos\left(\frac{\pi k}{4}\right)$ respectively. A complex process $Z[n] = X[n] + jY[n]$ is formed. Find the power spectrum of $Z[n]$.	10	4	3
5.	A random process X(t) having power spectrum $S_{XX}(\omega) = \frac{3}{49+\omega^2}$. is applied to a network for which $h(t) = t^2 e^{-7t} u(t)$. The network response is denoted by Y(t). i. What is the average power of X(t)? ii. Find the power spectrum of Y(t). iii. Find the average power of Y(t).	10	5	3