SRM Institute of Science and Technology
College of Engineering and Technology
DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu
Academic Year: 2021-2022

Mode of Exam
OFFLINE
SLOT-D1&D2

Test: CLA-3 Date: 28/06/2022
Course Code & Title: 18MAB203T / Probability and Stochastic Processes Duration: 1.00 pm -2.40 pm
Year & Sem: II & IV Max. Marks: 50

Course Articulation Matrix:

At the end of this course, learners will be able to:			Program Outcomes (PO)											
Course Outcomes (CO)		Learning Bloom's Level	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Compare the fundamentals between discrete and continuous random variables.	4	3	3										
CO2	Choose the model and analyze systems using two dimensional random variables.	4	3	3										
CO3	Describe limit theorems using various inequalities.	4	3	3										
CO4	Interpret the characteristics of random processes.	4	3	3										
CO5	Evaluate problems on spectral density functions and linear time invariant systems.	4	3	3										
CO6	Explain how random variables and stochastic processes can be described and analyzed.	4	3	3										

Part – A (10 x 1 = 10 Marks)
Answer all the questions

Q. No.	Question	Marks	BL	CO	PO	PI Code
1	If $\{X(t)\}$ is a stationary process, $E\{X(t)\}$ and $Var\{X(t)\}$ are A. Markov process B. time process C. stationary process D. constants	1	2	4	1,2	1.2.2

2	If $\lim_{\tau \to \infty} R(\tau)$ exists, then the limit is equal to A. $E(X(t))$ B. $Var(X(t))$ C. $E(X^2(t))$ D. $[E(X(t))]^2$	1	2	4	1,2	1.2.2
3	If the process $\{X(t)\}$ and $\{Y(t)\}$ are independent, then $R_{XY}(\tau) =$ A. $E(X^2(t)).E(Y^2(t))$ B. $E(X(t)).E(Y(t)).\delta(t)$ C. 0 D. 1	1	2	4	1,2	1.2.2
4	If $\{X(t)\}$ and $\{Y(t)\}$ are independent WSS processes with zero mean, then the autocorrelation function of $\{Z(t)\}$, where $Z(t) = aX(t)Y(t)$ is A. $aR_{XX}(\tau).R_{YY}(\tau)$ B. $a^2R_{XX}(\tau).R_{YY}(\tau)$ C. $\sqrt{a}R_{XX}(\tau).R_{YY}(\tau)$ D. $\sqrt{aR_{XX}(\tau).R_{YY}(\tau)}$	1	2	4	1,2	1.2.2
5	If $\{X(t)\}$ is a random process with constant mean μ and if $\bar{X}_T = \frac{1}{2T}\int_{-T}^{T} X(t)dt$, then $\{X(t)\}$ is Mean-ergodic, provided A. $\lim_{T\to\infty}\{Var\,\bar{X}_T\} = 1$ B. $\lim_{T\to-\infty}\{Var\,\bar{X}_T\} = 1$ C. $\lim_{T\to\infty}\{Var\,\bar{X}_T\} = 0$ D. $\lim_{T\to-\infty}\{Var\,\bar{X}_T\} = 0$	1	1	4	1,2	1.2.2
6	The average power of Random process $\{X(t)\}$ is defined by A. $R_{XX}(\tau)$ B. $R_{XX}(0)$ C. $R_{XX}(-\tau)$ D. $S_{XX}(0)$	1	1	5	1,2	1.2.2
7	The power spectral density of random signal with auto correlation function $e^{-\lambda\|\tau\|}$ is A. $\frac{\lambda}{\lambda^2+\omega^2}$ B. $\frac{\omega}{\lambda^2+\omega^2}$ C. $\frac{2\lambda}{\lambda^2+\omega^2}$ D. $\frac{2\omega}{\lambda^2+\omega^2}$	1	2	5	1,2	1.2.2
8	Let $\{X(t)\}$ be a WSS process which is the input to a linear invariant system with unit impulse $h(t)$ and output $\{Y(t)\}$, then $S_{YY}(\omega) =$ A. $H(\omega)S_{XX}(\omega)$ B. $\|H(\omega)\|S_{XX}(\omega)$ C. $\|H(\omega)\|^2S_{XX}(\omega)$ D. $\|H(\omega)\|^2R_{XX}(\omega)$	1	1	5	1,2	1.2.2
9	The convolution form of the output of linear time invariant system is A. $Y(t) = \int_{-\infty}^{+\infty} h(u)X(t-u)du$ B. $Y(t) = \int_{-\infty}^{+\infty} h(t)X(t-u)du$ C. $Y(t) = \int_{0}^{+\infty} h(u)X(t-u)du$ D. $Y(t) = \int_{-\infty}^{+\infty} h(t)X(u)du$	1	1	5	1,2	1.2.2

10	$Y(t) = f[X(t)]$ and $Y(t+\tau) = f[X(t+\tau)]$ for any $\tau \in (-\infty, +\infty)$, we say $X(t)$ and $Y(t)$ form a A. real system B. causal system C. time invariant system D. time dependent system	1	1	5	1,2	1.2.2

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Part-B (4 x 10= 40 Marks)

Answer Any TWO Questions

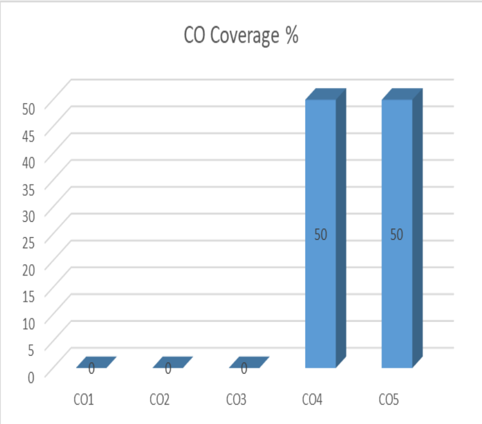
11	Show that the random process $X(t) = A\cos\lambda t + B\sin\lambda t$, where A and B are random variables is WSS if (i) E(A)=E(B)=0, (ii) $E(A^2) = E(B^2)$ and (iii) $E(AB) = 0$.	10	3	4	1,2	2.8.1
12	Consider the random process $X(t) = Y\cos\omega t, t \geq 0$, where ω is a constant and Y is a uniform random variable over (0,1). Find (i) average of X(t) (ii) autocorrelation function $R_{XX}(\tau)$.	10	4	4	1,2	2.8.1
13	A WSS random process X(t) with autocorrelation function $R_{XX}(\tau) = e^{-a\lvert\tau\rvert}$, where a is a real positive constant is applied to the input of a linear time invariant system with impulse response $h(t) = e^{-bt}, t \geq 0$, where b is a real positive constant. Find the power spectral density $S_{YY}(\omega)$ and also the autocorrelation function of the output Y(t) of the system.	10	4	4	1,2	2.8.1

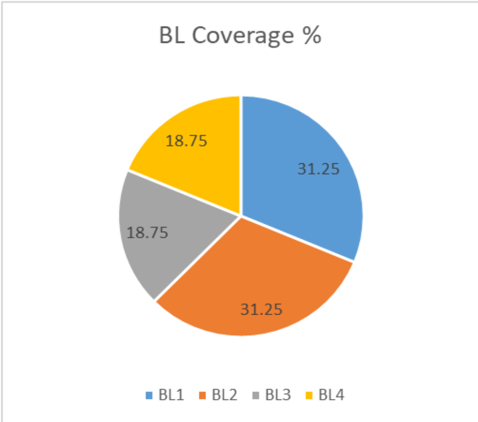
Answer Any TWO Questions

14	Determine the mean square value of the process for the given power spectral density of a continuous process $S_{xx}(\omega) = \dfrac{157 + 12\omega^2}{(16+\omega^2)(9+\omega^2)}$.	10	3	5	1,2	2.8.1
15	If X(t) is a WSS process with autocorrelation function $R_{XX}(\tau)$ and if $Y(t) = X(t+a) - X(t-a)$, and $R_{YY}(\tau) = 2R_{XX}(\tau) - R_{XX}(\tau+2a) - R_{XX}(\tau-2a)$. Show that $S_{YY}(\omega) = 4\sin^2(a\omega)S_{XX}(\omega)$.	10	3	5	1,2	2.8.1

16	The cross power spectrum of a real random process X(t) and Y(t) is given by $S_{XY}(\omega) = \begin{cases} a+ib\omega, & \lvert\omega\rvert \le 1, \\ 0, & \text{otherwise.} \end{cases}$ Find cross correlation function $R_{XY}(\tau)$.	10	4	5	1,2	2.8.1

Course Outcome (CO) and Bloom's level (BL) Coverage in Questions





Evaluation Sheet

Name of the Student:

Register No.

R	A													

Part - A (10x1=10 Marks)			
Q. No	CO	Marks Obtained	Total
1	4		
2	4		
3	4		
4	4		
5	4		
6	5		
7	5		
8	5		
9	5		
10	5		
Part- B (4x10= 40 Marks)			
Answer any two questions			
11	4		

12	4		
13	4		
Answer any two questions			
14	5		
15	5		
16	5		

Consolidated Marks:

CO	Marks Scored
CO4	
CO5	
Total	

Signature of the Course Teacher