SRM Institute of Science and Technology
College of Engineering and Technology
DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

Mode of Exam
OFFLINE
SLOT-D2

Academic Year: 2021-2022

Test: CLA-3 Date: 23/06/2022
Course Code & Title: 18MAB203T / Probability and Stochastic Processes Duration: 10.00 am -11.40 am
Year & Sem: II & IV Max. Marks: 50

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										

Course Articulation Matrix:

Part – A (10 x 1 = 10 Marks) Answer all the questions						
Q. No.	Question	Marks	BL	CO	PO	PI Code
1	A random process consists of three sample function $X(t, s_1) = 2$, $X(t, s_2) = 2\cos t$ and $X(t, s_3) = 3\sin t$ each occurring with equal probabilities then the mean of {X(t)} is (a) $\frac{2}{3}$ (b) $\frac{1}{3}[2 + 2\cos t + 3\sin t]$	1	2	4	1,2	1.2.2

	(c) $\frac{1}{2}[\cos t+\sin t]$ (d) 0					
2	If the autocorrelation function $R_{XX}(\tau)=18+\frac{2}{6+\tau^2}$, then $E[X^2(t)]$ is (a) $\frac{55}{3}$ (b) 18 (c) $3\sqrt{2}$ (d) $\sqrt{2}$	1	2	4	1,2	1.2.2
3	Which of the following is valid autocorrelation function? (a) $\frac{a\cos\tau}{\tau}$ (b) $\tau^2+\tau^3$ (c) $\frac{1}{1+4\tau^2}$ (d) $\frac{\sin\tau}{\tau^2}$	1	2	4	1,2	1.2.2
4	If X(t) and Y(t) are independent WSS process with zero means, and if Z=a X(t) Y(t) then $R_{ZZ}(\tau)$ is given by (a) 0 (b) $a\,E[X(t)]E[Y(t)]$ (c) $a^2[R_{XX}(\tau)+R_{YY}(\tau)]$ (d) $a^2 R_{XX}(\tau)R_{YY}(\tau)$	1	2	4	1,2	1.2.2
5	If $\{X(t)\}$ is a random process with constant mean μ and if $\overline{X}_T=\frac{1}{2T}\int_{-T}^{T}X(t)\,dt$ then $\{X(t)\}$ is mean-ergodic provided, (a) $\underset{T\to\infty}{Lt}\,Var\overline{X}_T=0$ (b) $\underset{T\to 0}{Lt}\,Var\overline{X}_T=0$ (c) $\underset{\overline{X}_T\to 0}{Lt}\,Var\overline{X}_T=0$ (d) $\underset{\overline{X}_T\to\infty}{Lt}\,Var\overline{X}_T=0$	1	1	4	1,2	1.2.2
6	The power spectral density of a WSS process is always (a) positive (b) negative (c) non-positive (d) non-negative	1	1	5	1,2	1.2.2
7	Imaginary part of $S_{XY}(\omega)$ is an (a) Odd function (b) even function (c) neither even nor odd (d) trail function	1	1	5	1,2	1.2.2
8	If X(t) and Y(t) are orthogonal, then $S_{XY}(\omega)$ and $S_{YX}(\omega)$ are respectively, (a) 0, 0 (b) 1, 0 (c) 0, 1 (d) 1, 1	1	1	5	1,2	1.2.2
9	If the system has an impulse response $h(t)=e^{-at}, t\geq 0$, then the power spectral density of the output Y(t) corresponding to the input X(t) is (a) $\frac{1}{a^2+\omega^2}S_{XY}(\omega)$ (b) $\frac{a}{a^2+\omega^2}S_{XX}(\omega)$ (c) $\frac{1}{a^2+\omega^2}S_{XX}(\omega)$ (d) $\frac{1}{a^2+\omega^2}S_{YX}(\omega)$	1	2	5	1,2	1.2.2

10	If the autocorrelation function $R_{xx}(\tau)=e^{-\lambda\lvert\tau\rvert}$, then the power spectral density $S_{xx}(\omega)$ of the process is given (a) $\frac{2\lambda}{\lambda^2+\tau^2}$ (b) $\frac{2\lambda}{\lambda^2+\omega^2}$ (c) $\frac{4\lambda}{\lambda^2+\tau^2}$ (d) $\frac{4\lambda}{\lambda^2+\omega^2}$	1	2	5	1,2	1.2.2

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Part-B (4 x 10= 40 Marks)

Answer Any TWO Questions

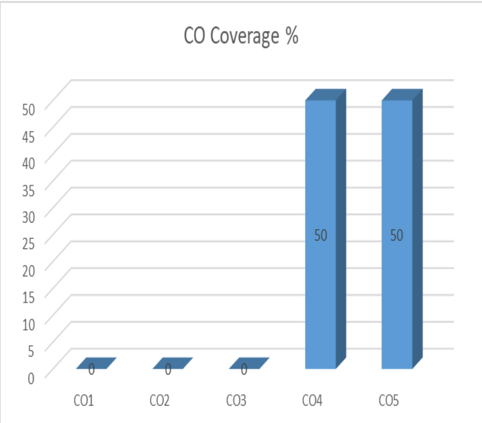
11	Show that the given random process $X(t)=A\cos(\omega t+\theta)$ is wide-stationary, where A and ω are constants and θ is uniformly distribution in the interval $(0,2\pi)$.	10	3	4	1,2	2.8.1
12	The probability distribution of the process $\{X(t)\}$ is given by $P(X(t)=n)=\begin{cases}\frac{(at)^{n-1}}{(1+at)^{n+1}}, & n=1,2,3,\ldots\\ \frac{at}{1+at}, & n=0.\end{cases}$ Verify if the process is stationary.	10	4	4	1,2	2.8.1
13	If the random process $X(t)=U\cos t+V\sin t$, where U and V are independent random variable each of which assumes the values -2 and 1 with probabilities $\frac{1}{3}$ and $\frac{2}{3}$ respectively, compute $R_{xx}(\tau)$	10	4	4	1,2	2.8.1

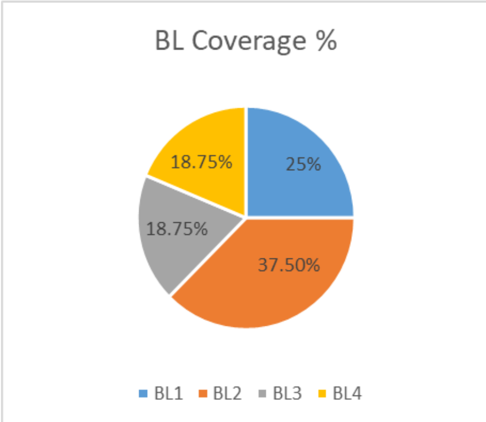
Answer Any TWO Questions

14	Determine the mean square value of the process for the given power spectral density of a continuous process $S_{xx}(\omega)=\frac{\omega^2+9}{\omega^4+5\omega^2+4}$.	10	3	5	1,2	2.8.1
15	The auto correlation function of the ergodic process X(t) is $R_{xx}(\tau)=\begin{cases}1-\lvert\tau\rvert, & \lvert\tau\rvert\le 1,\\ 0, & \text{otherwise}\end{cases}$. Obtain the spectral density of X(t).	10	3	5	1,2	2.8.1

16	A wide-sense stationary process X(t) is the input to the linear system with impulse response $h(t) = 2e^{-7t}, t \geq 0$. If the autocorrelation function of X(t) is $R_{xx}(\tau) = e^{-4\|\tau\|}$, estimate the power spectral density of the output process Y(t).	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