K. J. Somaiya Institute of Technology, Sion, Mumbai-22
(Autonomous College Affiliated to University of Mumbai)

Subject Code: EXC 504 Subject Name: Random Signal Analysis
Date 02-06-23

May / June 2023

Program: B.Tech .(Electronics and Telecommunication) Examination: TY Semester: V			
Course Code: EXC 504 and Course Name: Random Signal Analysis			
Duration: 2.5 Hours			Max. Marks: 60
Instructions: (1)All questions are compulsory. (2)Draw neat diagrams wherever applicable. (3)Assume suitable data, if necessary.			

		Max. Marks	CO	BT level
Q 1	Solve any six questions out of eight:	12		
i)	Define Joint and conditional probability.	2	CO1	R
ii)	State properties of Distribution function (any two)	2	CO2	R
iii)	Determine mean of uniform distribution.	2	CO2	Ap
iv)	State any two properties of characteristics function .	2	CO3	R
v)	Define Covariance and correlation coefficient.	2	CO4	R
vi)	Define SSS and WSS	2	CO5	R
vii)	State any two properties of power spectral density function	2	CO5	R
viii)	What is steady state probability	2	CO6	R
Q.2	Solve any four questions out of six:	16		
i)	A certain test for a particular cancer is known to be 95 % accurate. A person submits to the test and result is positive. Suppose that a person comes from a population of 100,000 where 2000 people suffer from that disease. What can we conclude about the probability that the person under test has that particular cancer?	4	1	Ap
ii)	Compute MGF of Normal Distribution	4	2	Ap

iii)	If X and Y are two independent random variates with pdf. $f_X(x)=e^{-x}$, $x>0$ and $f_Y(y)=3e^{-3y}$, $y>0$, find $f_Z(z)$ if $Z=X/Y$.	4	3	Ap
iv)	If $X=\cos\Theta$, $Y=\sin\Theta$, where Θ is uniformly distributed over $(0,2\pi)$, prove that i) X and Y are not correlated. ii) X and Y are not independent	4	4	Ap
v)	A random process is given by $Z(t)=X_1\cos w_o t - X_2 \sin w_o t$ where X_1 and X_2 are independent normal variates both with zero means and variances. compute $E(Z)$, $E(Z^2)$ and $Var(Z)$.	4	5	Ap
vi)	The transition probability matrix of a Markov chain with three states 1,2,3 is given by $P=\begin{bmatrix}0.5 & 0.4 & 0.1\\ 0.3 & 0.4 & 0.3\\ 0.2 & 0.3 & 0.5\end{bmatrix}$ Find limiting probabilities.	4	6	Ap
Q.3	Solve any two questions out of three.	16		
i)	A binary communication transmitter sends data as one of two types of signals denoted by 0 or 1. Due to noise, sometimes a transmitted 1 is received as 0 and vice versa. if probability that a transmitted 0 is correctly received as 0 is 0.9 and the probability that a transmitted 1 is correctly received as 1 is 0.8 and if the probability of transmitting 0 is 0.45, i) find the probability that a one is received? ii) find the probability that a zero is received iii) find probability that a 1 was transmitted given that 1 was received iv) find the probability that an error is committed?	8	1	Ap
ii)	A two dimensional random variable (X,Y) has the following distribution $f_{XY}(x,y)=2e^{-(x+y)}$, $0<y<x<\infty$; $=0$, elsewhere. Compute i) $E(XY)$, ii) $cov(X,Y)$.	8	4	Ap
iii)	If a random process is given by $X(t)=A\cos wt$, where w is a constant and A is a random variable with uniform distribution over (0,1). Find autocorrelation function $R_{X,X}(t_1,t_2)$ and autocovariance $C_{X,X}(t_1,t_2)$ of X(t).	8	5	Ap

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Q.4	Solve any two questions out of three.	16		Ap
i)	The transmission time X of messages in a communication system obeys the following exponential probability law with parameter λ. $f(x)= k\, e^{-\lambda x}$,x>0, find k and pdf of X and cdf $F_X(x)$,Also sketch two functions	8	2	Ap
ii)	A continuous random variable has pdf $f(x)=k(x-x^2)$, $0\leq x\leq 1$,compute k ,mean and variance.	8	3	Ap
iii)	The transition probability matrix of a Markov chain with three states 1,2,3 is given by $P=\begin{bmatrix}0.1 & 0.5 & 0.4\\ 0.6 & 0.2 & 0.2\\ 0.3 & 0.4 & 0.3\end{bmatrix}$ And the initial state distribution is $P^o=[0.7\ \ 0.2\ \ 0.1]$, Compute : i) $P(X_2=2)$ ii) $P(X_2=3)$ ii)$P[X_3=2,X_2=3,X_1=3,X_O=2]$.	8	6	Ap

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