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

Subject Code: EXC 504
Date:9 /12/2022

Subject Name: Random Signal Analysis

Nov – Dec 2022
Program: B.Tech..(Electronics and Telecommunication)
Examination: TY Semester: V
Course Code: EXC504 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)	State any two properties of probability density function.	02	**CO** 1	U
ii)	State any two axioms of Probability	02	**CO** 2	R
iii)	State Chapman-Kolmogorov equation	02	**CO** 3	Ap
iv)	Let X be a continuous random variable with p.d.f $f(x)=k*x(1-x), 0 \leq x \leq 1$,Find value of k.	02	**CO** 3	Ap
v)	Define Moment generating function for discrete and continuous random variable	02	**CO** 4	R
vi)	What is conditional mean and Correlation of two dimensional random variables?	02	**CO** 4	R
vii)	Compare between Strict sense stationary process and wide sense stationary process(any two points)	02	**CO** 5	R
viii)	Define Markov Chain with example.	02	**CO** 6	R
Q.2	Solve any four questions out of six.	16		
i)	Explain Bayes theorem	04	**CO** 1	R,U
ii)	Define and explain moment generating function.	04	**CO** 2	R
iii)	State any four properties of Autocorrelation function.	04	**CO** 3	Ap
iv)	State and explain Central limit theorem.	04	**CO** 4	Ap
v)	A random process is given by $x(t)=A\sin(wt+Y)$ where Y is uniformly distributed over $(0,2\pi)$, Compute Autocorrelation of random process x(t).	04	**CO** 5	Ap

vi)	Prove Chapman-Kolmogorov equation for discrete Markov chain.	04	CO 6	U
Q.3	Solve any two questions out of three.	16		
i)	In communication system, a zero is transmitted with probability 0.3 and one is transmitted with probability 0.7. Due to noise in channel, a zero is received as one with probability 0.2 , Similarly a one is received as zero with probability 0.4. i)What is the probability that a one is received? ii)It is observed that a one is received, what is the probability that zero was transmitted? iii) What is the probability that an error is committed?	08	CO 1	Ap
ii)	The joint probability density function of two dimensional random variable (X,Y) is given by $f(x,y)=((x-y)^2)/40, -1< x <1, -3<y<3$ $= 0$, elsewhere i)Estimate the marginal density functions of X and Y ii)compute mean and variance of X and Y	08	CO 4	Ap
iii)	A random process is given by $X(t)=A\cos(w_o t+\theta)$ where θ is uniformly distributed in $(-\pi,\pi)$. where A and w_o are constant, show that random process X(t) is correlation ergodic.	08	CO 5	Ap
Q.4	Solve any two questions out of three.	16		
i)	Define Normal distribution and find its mean and variance. State properties of CDF.(any two)	08	CO2	Ap
ii)	In medical imaging such as computer tomography, relation between the detector reading y and body absorptivity x follows a law $y=e^x$. Let X be $N(\mu, \sigma^2)$ .Compute probability density function of y .Also Explain function of one random variable.	08	CO 3	Ap
iii)	The transition probability matrix of a Markov chain with three states 1,2,3 is given by 123 $P=\begin{bmatrix} 0.2 & 0.5 & 0.3 \\ 0.5 & 0.4 & 0.1 \\ 0.3 & 0.4 & 0.3 \end{bmatrix}$ And the initial state distribution is $P^o=[0.6\ \ 0.2\ \ 0.1]$, Compute i) $P(X_2=2)$ ii) $P(X_2=3)$ ii)$P[X_3=2, X_2=3, X_1=3, X_O=2]$.	08	CO 6	Ap

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