

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

Nov – Dec 2024		
Program: B. Tech. Scheme IIB		
Regular & Backlog Examination: TY Semester		
Course Code: EXC504 and Course Name: Random Signal Analysis		
Date of Exam: 27/11/2024	Duration: 02.5 Hours	Max. Marks: 60

Instructions:
 (1) All questions are compulsory.
 (2) Draw neat diagrams wherever applicable.
 (3) Assume suitable data, if necessary.

Q. No.	Question	Max. Marks	CO	BT level
Q 1.	Solve any two questions out of three: (05 marks each)	10		
a)	In a box, there are four tags numbered 1 and six tags numbered 2. There are two urns U1 and U2 containing 3 red and 7 black balls and 8 red and 2 black balls respectively. One tag is drawn from the box and none ball is drawn from the urn whose number is found on the tag drawn. Calculate the probability that a red ball is drawn.		1	Ap
b)	A hospital switch board receives an average of 4 emergency calls in a 10 minutes interval. Compute the probability that i) there are atmost 2 emergency calls ii) there are exactly 3 emergency call in an interval of 10 minutes?		2	Ap
c)	If the probability density function of X is $f_x = e^{-x}, x > 0$, Determine the probability density function of $Y = 2x + 1$.		3	Ap
Q 2.	Solve any two questions out of three: (05 marks each)	10		
a)	A two dimensional Random variable (X,Y) has the joint density $f(x,y) = 24xy$; $x > 0, y > 0, x+y \leq 1$ =0 ; otherwise calculate marginal density function of x and conditional probability density function of Y for given X.		4	Ap
b)	Compute autocorrelation function of a random process given by $X(t) = a \cos(bt + Y)$, where a,b are constants and Y is a uniform random variable on $(-\pi, \pi)$.		5	Ap
c)	Consider a Markov Chain with 2 states and transition probability matrix of a Markov chain is given by		6	Ap

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	$P = \begin{bmatrix} 3/4 & 1/4 \\ 1/2 & 1/2 \end{bmatrix}$ Calculate stationary probabilities.			
Q 3.	Solve any two questions out of three. (10 marks each)	20		
a)	In a communication system, '0' is transmitted with probability 0.4 and a one is transmitted with probability 0.6. Due to noise in the channel, a zero can be received as one with probability 0.1 and as a zero with probability 0.9 similarly, one can be received as zero with probability 0.1 and as a one with probability 0.9. i) if a one is observed, Determine the probability that a zero was transmitted? ii) compute probability that '1' was transmitted given that '1' was received?		1	Ap
b)	The joint pdf of random variable X,Y is given by $f(x,y) = k e^{-3x-5y}; X \geq 0, y \geq 0$ $f(x,y) = 0$; elsewhere a) Calculate value of k , the marginal pdf of X and Y, b)compute E[X/Y].		4	Ap
c)	If a random process {x(t)} is given by $X(t) = A \cos(\omega_0 t + \theta)$ where θ is uniformly distributed over $(-\pi, \pi)$, prove that {x(t)} is correlation ergodic.		5	Ap
Q 4.	Solve any two questions out of three. (10 marks each)	20		
a)	X is a normal variate with mean 30 and standard deviation 5. Compute the probabilities that i) $26 \leq X \leq 40$, ii) $X \geq 45$, iii) $ X - 30 \geq 5$.		2	Ap
b)	Let X be a continuous random variable with uniform probability density function in $(0, 2\pi)$, calculate probability density function and distribution function of $Y = \cos X$.		3	Ap
c)	The Transition Probability matrix of a Markov Chain $\{X_n\}, n=1,2,3$ having three states 1,2 and 3 is: $P = \begin{bmatrix} 0.2 & 0.5 & 0.3 \\ 0.5 & 0.4 & 0.1 \\ 0.3 & 0.4 & 0.3 \end{bmatrix}$ The Initial Probability distribution is $p^{(0)} = (0.6, 0.3, 0.1)$ Calculate i) $P(X_2=2)$ ii) $P(X_2=3)$ iii) $P(X_3=2, X_2=3, X_1=3, X_0=2)$		6	Ap
