Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech (Hons.) Degree Examination June 2024 (2022 Admission)

Course Code: ECT294

Course Name: STOCHASTIC PROCESSES FOR COMMUNICATION

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1	A box B1 contains 20 white balls 10 white balls and 5 red balls and a box B2 contains 20 white and 20 red balls. A ball is drawn from each box. What is the probability that the ball from B1 will be white and the ball from B2 red?	3
2	Define white noise in terms of power spectral density.	3
3	Distinguish between strict stationarity and weak stationarity random processes	3
4	Consider a source transmitting six symbols with probability given as 1/2,1/4,1/8,1/16,1/32,1/32. Find the entropy.	3
5	With neat sketch prove the relation between mutual information and entropy.	3
6	State source coding theorems for discrete memoryless source.	3
7	Define discrete-time Markov chain.	3
8	Distinguish between the three components of queuing.	3
9	What is meant by collision in a packet transmission network?	3
10	Describe application of slotted ALOHA.	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) Let X and Y be jointly continuous random variables with joint PDF — 7

$$f_{X,Y}(x,y) = \begin{cases} 6e^{-(2x+3y)}, & x,y \geq 0 \\ 0, & otherwise \end{cases}$$

C X and Y are independent? Find E(Y|X>2) and P(X>Y).

b) Classify different types of random processes in detail. — 7

12 a) Let A, B be two independent events. Show that A and B are independent. — 5

b) Compare Gaussian pdf with Rayleigh pdf. — 9

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Module -2

13	a)	Show that $R_{xy}(\tau) \leq \frac{1}{2}\left[R_{xx}(0) + R_{yy}(0)\right]$.	8
	b)	Differentiate between Strict Sense Stationary Process and Wide Sense Stationary Process.	6
14	a)	How do matched filter maximize SNR?	7
	b)	A random process Y(t) = X(t) – X(t+τ) is defined in terms of process X(t). Show that mean value of Y(t) is 0 even if X(t) has nonzero mean value.	7

Module -3

15	a)	Derive the channel capacity of the binary-symmetric channel with crossover probability.	7
	b)	Show that the marginal entropy is greater than or equal to the conditional entropy [H(X)≥ H(X/Y)].	7
16		Consider a BSC with P(x1) = α. (a) Show that the mutual information I(X;Y) is given by I(X;Y) = H(Y) + p log_2p + (1 – p) log_2 (1 – p) (ii) Calculate I(X;Y) for α = 0.5 and p =0.1. (iii) Repeat part (ii) for α = 0.5 and p = 0.5, and comment on the result. (iv) Find channel capacity of BSC	14

Module -4

17	a)	Explain a Poisson random process. Give two practical examples of a Poisson process	7
	b)	A customer service center receives calls following a Poisson process with an average rate of 5 calls per hour. How long does it take on for the center to receive the next call after a call has just been answered?	7
18	a)	Professor Symons either walks to school, or he rides his bicycle. If he walks to school one day, then the next day, he will walk or cycle with equal probability. But if he bicycles one day, then the probability that he will walk the next day is ¼. Express this information in a transition matrix.	4
	b)	State the postulates of Poisson process and derive the probability distribution.	10

Module -5

19	a)	Explain how packet transmission in slotted ALOHA can be modelled using DTMC. Draw the state transition diagram.	14
20	a)	Explain M/M/I queue system pertaining to packet transmission.	14

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