Reg. No. | | | | | | | | |

G. VENKATASWAMY NAIDU COLLEGE (AUTONOMOUS), KOVILPATTI – 628 502.

UG DEGREE END SEMESTER EXAMINATIONS - NOVEMBER 2024.

(For those admitted in June 2021 and later)

PROGRAMME AND BRANCH: B.Sc., STATISTICS

SEM	CATEGORY	COMPONENT	COURSE CODE	COURSE TITLE
V	PART - III	CORE	U21ST509	STOCHASTIC PROCESSES

Date & Session: 11.11.2024 / FN **Time : 3 hours** **Maximum: 75 Marks**

Course Outcome	Bloom's K-level	Q. No.	**SECTION – A (10 X 1 = 10 Marks)** Answer **ALL** Questions.
CO1	K1	1.	Which of the following distributions has the property that its mean is equal to its variance? a) Bernoulli b) Binomial c) Poisson d) Geometric
CO1	K2	2.	In a discrete-time Markov chain, what property describes the transition probabilities? a) Future states depend only on the current state. b) Future states depend on all previous states. c) Transition probabilities are always zero. d) Transition probabilities change continuously over time
CO2	K1	3.	What property characterizes a Markov Chain? a) The next state depends on all previous states b) The next state depends only on the current state c) The next state is deterministic based on previous states. d) The next state is independent of the current state.
CO2	K2	4.	In a Markov Chain, what is the Transition Probability Matrix used for? a) To calculate the mean and variance of the process. b) To represent the probabilities of moving from one state to another. c) To determine the stationary distribution of the chain. d) To generate random variables independent of the process.
CO3	K1	5.	Which of the following best describes a recurrent state in a Markov Chain? a) A state that can be visited infinitely often with a probability of 1. b) A state that can only be visited once. c) A state that cannot be reached from any other state. d) A state that leads to absorbing states.
CO3	K2	6.	In a Markov Chain, if every state can be reached from every other state, the chain is classified as: a) Absorbing b) Transient c) Irreducible d) Periodic
CO4	K1	7.	Which of the following statements is true about the Poisson process? a) It has independent increments. b) The number of events in any interval is dependent on the number of events in previous intervals. c) It can have a variable rate of occurrence for each interval. d) It is not memoryless.

CO4	K2	8.	What distribution describes the number of events in a fixed interval of time for a Poisson process with rate λ? a) Geometric Distribution b) Exponential Distribution c) Normal Distribution d) Poisson Distribution
CO5	K1	9.	Which of the following best describes a branching process in discrete time? a) A process where the probability of branching depends on continuous time intervals. b) A process where each individual in a generation produces a random number of offspring in the next generation, following a fixed probability distribution. c) A process with constant growth rate, independent of the current population. d) A process where the number of offspring produced at each step follows a deterministic pattern.
CO5	K2	10.	What is the probability of extinction in a branching process where the mean number of offspring is less than or equal to 1? a) Always 0 b) Always 1 c) Can be either 0 or 1 depending on variance d) Greater than 0 but less than 1
Course Outcome	**Bloom's K-level**	**Q. No.**	**<u>SECTION – B</u> (5 X 5 = 25 Marks)** **Answer <u>ALL</u> Questions choosing either (a) or (b)**
CO1	K3	11a.	Explain the Probability Generating Function (PGF) and derive the PGF for a Bernoulli distribution with parameter p. **(OR)**
CO1	K3	11b.	Calculate the mean and variance of a Poisson distribution with parameter λ.
CO2	K3	12a.	Define a Markov Chain and provide an example. **(OR)**
CO2	K3	12b.	Explain the concept of the Transition Probability Matrix in a Markov Chain.
CO3	K4	13a.	Define and differentiate between transient and recurrent states in a Markov Chain. **(OR)**
CO3	K4	13b.	Explain the concept of higher transition probabilities in a Markov Chain.
CO4	K4	14a.	Define a Poisson process. What are the key properties that characterize a Poisson process? **(OR)**
CO4	K4	14b.	Explain the relationship between the Poisson process and the exponential distribution.
CO5	K5	15a.	Define a discrete-time branching process. Provide one real-world example where this process can be applied. **(OR)**
CO5	K5	15b.	What is the role of the probability generating function in analyzing a discrete-time branching process?

Course Outcome	Bloom's K-level	Q. No.	**SECTION – C (5 X 8 = 40 Marks)** **Answer ALL Questions choosing either (a) or (b)**
CO1	K3	16a.	Discuss the classification of stochastic processes and provide examples for each category.
			(OR)
CO1	K3	16b.	Derive the mean and variance for a Binomial distribution X~Binomial(n,p), and discuss its Probability Generating Function.
CO2	K4	17a.	Discuss the concept of Higher Transition Probabilities in a Markov Chain and how they are calculated.
			(OR)
CO2	K4	17b.	Explain the generalization of independent Bernoulli trials in the context of Markov Chains. Provide an example.
CO3	K4	18a.	Discuss the stability of a Markov system and the conditions under which a Markov Chain is considered stable. Provide examples of stable and unstable chains.
			(OR)
CO3	K4	18b.	Consider the Markov chain with TPM; $P = \begin{bmatrix} 0 & 1 & 0 \\ 1/2 & 0 & 1/2 \\ 0 & 1 & 0 \end{bmatrix}$. Show that, All the states of the chain are periodic and non-null persistent.
CO4	K5	19a.	Describe the birth-death process and explain how it is related to the Poisson process. Provide examples of real-world systems modeled by birth-death processes.
			(OR)
CO4	K5	19b.	Discuss the Generalized Poisson Process and compare it to the standard Poisson Process. What modifications are made to extend the basic Poisson process?
CO5	K5	20a.	Derive the mean and variance of a branching process using the probability generating function. How do these quantities help in understanding the population dynamics of the process?
			(OR)
CO5	K5	20b.	Discuss the probability of extinction in a branching process. How is it determined using the probability generating function? Provide an example to illustrate the conditions under which extinction is certain or uncertain.