QP CODE: 25047359

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Reg No : .....

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M.Sc DEGREE (CSS) EXAMINATION, NOVEMBER 2025

Third Semester

M Sc BIOSTATISTICS

Core Course - ST020302 - STOCHASTIC MODELS AND TIME SERIES ANALYSIS

2019 ADMISSION ONWARDS

1930F1E3

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Suppose three children stand in a circle and they play throwing a ball game. The rule is that the child having a ball in a step will through it either of the other two children with equal probability. If X_n is the number of the child having the ball at the n^{th} step, write down the first and second step transition matrices.
2. Define communication between states.
3. Define stationary distribution of a Markov chain. What is its use?
4. Distinguish between stationary processes and evolutionary processes.
5. Explain a discrete State continuous time Markov chain and give an example.
6. What is a pure death process?
7. Explain a Poisson Processes as a renewal process.
8. Define an autoreggressive process.
9. What is a white noise process?
10. Define auto covariance function and auto correlation function

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Describe the four types of stochastic processes giving suitable examples.
12. There are two urns where Urn 1 contains three white balls and Urn 2 contains three black balls. At each stage one ball each taken from the urns and are Interchanged. Let X_n denote the number of white balls in Urn 1 at the n^{th} step. Write down the state space and transition Matrix of $\{X_n\}$. Classify the states of the Markov chain.

13. Derive the Kolmogrov differential equations for an M/M/1 queue and obtain its distribution under stationary analysis

14. Explain a birth and death process and state its postulates. Also, derive the Kolmogrov forward and backward differential equations.

15. State key renewal theorem and point out it's applications.

16. Distinguish between moving average and autoregressive models. Show that an AR(1) model is an $\mathrm{MA}(\infty)$process.

17. Describe an AR (1) model with the stationary marginal distribution of exponential. Derive the structure of the innovation sequence $\{\epsilon_n\}$.

18. Describe the important components of a time series.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Describe an example of a countable state Markov chain. Write down its state space and transition matrix.

20. a) State the postulates of a Poisson process and derive its probability distribution.
b) Show that the sum of two independent Poisson processes is another Poisson process. Is it true for their difference?

21. a) Explain a Galton –Watson branching process. Give an illustration.
b) Obtain probability generating function relationship of a branching process.

22. Explain Box –Jenkins methodology for the analysis of a given time series data. Write down the important steps for diagnostic checking of such models. Describe their applications in biostatistical contexts.

(2×5=10 weightage)