

Roll No. ....

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CMTE/D-24

24055

## MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Paper–MT–CSE–20–11

Time Allowed : 3 Hours]

[Maximum Marks : 75

**Note** : Attempt **five** questions in all, selecting **one** question from each Unit. Question No. **1** is compulsory. All questions carry equal marks.

### Compulsory Question

1. Answer the following questions in brief :  $5 \times 3 = 15$
- (a) Define Markov Chain. What are some applications of Markov Chains?
  - (b) What is a Probability mass function (PMF)?
  - (c) What types of Random sampling exist?
  - (d) What is the difference between a parameter and a statistic?
  - (e) How do we determine if two Graphs are isomorphic?

### UNIT-I

2. (a) What are Probabilistic inequalities? What is the significance of Probabilistic inequalities in statistical theory, and how do they help in bounding probabilities? 8

- (b) Why is the Central Limit Theorem important for understanding confidence intervals? 7

3. (a) What is the variance of a discrete random variable, and how is it computed? A discrete random variable  $X$  takes the values  $x = 1, 2, 3, 4$  with corresponding probabilities : 8

$$P(X = 1) = 0.1, P(X = 2) = 0.3, P(X = 3) = 0.4, \\ P(X = 4) = 0.2.$$

Calculate the variance of  $X$ .

- (b) What is the cumulative distribution function (CDF), and how does it relate to the PMF ? 7
- (c) Distinguish between specialization and generalization. Draw an EER diagram to illustrate specialization. 5

### UNIT-II

4. (a) What are the limitations of the Method of Moments, and how might it lead to inefficient estimators? 8
- (b) What is the concept of a Random sample, and how does it differ from a nonrandom sample in terms of bias and representativeness? 7
5. What is a sampling distribution, and why is it important in understanding the properties of estimators? How does the sampling distribution of an estimator help us assess its bias and efficiency? 15

### UNIT–III

6. (a) In multivariate analysis, how can you deal with missing data, and what techniques are available to handle missing values in high-dimensional datasets? 8
- (b) What are the steps involved in performing PCA on a dataset, and how do you interpret the results at each stage? 7
7. (a) In the context of multivariate regression analysis, how do you interpret the coefficients of the model, especially when the predictors are correlated? 8
- (b) What is Principal Component Analysis (PCA), and what are its main objectives in data analysis? 7

### UNIT–IV

8. (a) Discuss the relationship between graph colouring and the chromatic number in bipartite graphs. 8
- (b) Can a graph with more than four vertices have fewer than four edges and still be planar? 7
9. Define the concept of Combinations with repetition. Derive and explain the formula for selecting  $r$  objects from  $n$  distinct objects when repetition is allowed. Provide an example to demonstrate how this formula is applied.

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