M.Sc. (CA) SEMESTER - I
M.Sc. (CA) PAPER - I
TITLE: MATHEMATICAL FOUNDATION
PAPER CODE: CSA4101

[CREDITS - 4]

Learning Objective:
1. To provide basic mathematical foundations required for various computer science courses.

	Title and Contents	No. of Lectures
Unit - I	**Sets, Relations and Functions** 1.1 Sets 1.2 Relations and functions 1.3 Methods of proof 1.4 Equivalence relations 1.5 Cardinality	**5**
Unit - II	**Introductory Logic** 1.1 Fundamentals of Logic 1.2 Logic operators such as AND, OR etc., Truth tables 1.3 Logical inferences 1.4 Methods of proofs of an implication 1.5 First order logic 1.6 Predicate calculus Predicates and Quantifiers 1.7 Rules of inference for quantified propositions	**7**
Unit - III	**Recurrence Relations** 3.1 Recursion 3.2 Forming and solving recurrence relations by substitution method and generating function 3.3 Method of characteristic roots 3.4 Solving non homogeneous recurrence relations	**7**
Unit - IV	**Theory of Graphs** 4.1 Graphs 4.2 Subgraphs 4.3 Isomorphism Proofs 4.4 Types of graphs 4.5 Paths and cycles 4.6 Adjacency matrices 4.7 Transitive closure 4.8 Connectivity 4.9 Directed acyclic graphs 4.10 Planar graphs and Euler's formula 4.11 Dual of a graph 4.12 Hamiltonian and Eulerian graphs 4.13 Applications like matching and colouring graphs 4.14 Graph traversals (BFS and DFS) 4.15 Trees 4.16 Spanning trees	**10**
Unit - V	**Probability and Random Vectors** 5.1 Introduction to regular expression to finite automata 5.2 Random vectors 5.3 Conditional Probability 5.4 Bayes Rule	**7**

	5.5 Multivariate Gaussian 5.6 Random Processes	
Unit - VI	**Basics of statistics** 6.1 Introduction to measure of central tendency and dispersion 6.2 Best linear unbiased estimator and weighted least-squares, maximum likelihood 6.3 Computing estimates: unconstrained optimization, stochastic gradient descent 6.4 Bayesian estimation 6.5 Hypothesis testing	**7**
Unit - VII	**Basics of Vector spaces** 7.1 Linear Vector spaces 7.2 Linear independence 7.3 Norms and Inner products 7.4 Bases and Orthobases 7.5 Examples: Bsplines, cosines / Fourier, radial basis Functions, etc. 7.6 Linear approximation (closest point in a subspace, Least squares - I)	**5**

References:

1. J. L. Mott, A. Kandel, T. P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians: PHI.
2. John Truss, Discrete Mathematics for Computer Science: Pearson International, 2001.
3. Introduction to Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill, 1975.
4. Liu, Computer Science: Mathematical Introduction: PHI.