15.1 Semester I

Code: BCA-1001T	CC-I	Mathematical Foundation for Computer Science – I	3L+T:0P	3 Credits (45 hours theory)

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75)

Course Outcomes: Upon completion of this course, students will be able to:

CO1: Understand the fundamental mathematical concepts such as sets, functions, matrix algebra, And discrete mathematics.

CO2: This course enables the students to use mathematical models and techniques to analyse and Understand problems in computer science.

CO3: Understand how mathematical principles provide succinct abstractions of computer science Problems and help them to efficiently analysis.

CO4: Understand Eigen values, Eigen vectors, and the Cayley-Hamilton Theorem, and analyse Matrix transformations and their applications in various domains.

Unit	Topics	Purposed lectures
I	**Set, Relation, and Function:** Set, Set Operations, Properties of Set operations, Subset, Venn Diagrams, Cartesian Products. Relations on a Set, Properties of Relations, Representing Relations using matrices and digraphs, Types of Relations, Equivalence Relation, Equivalence relation and partition on set, Closures of Relations, Warshall's algorithm. Functions, properties of functions (domain, range), composition of functions, surjective (onto), injective (one-to-one) and bijective functions, inverse of functions. Exponential and Logarithmic functions, Polynomial functions, Ceiling and Floor functions.	11
II	**Counting and Recurrence Relation:** Basics of counting, Pigeonhole Principle, permutations, combinations, Binomial coefficients, and Binomial Theorem. Recurrence relations, their order, and methods for solving linear recurrence relations with constant coefficients using characteristic equation roots (real roots only). Non-linear recurrence relations and generating functions.	11
III	**Elementary Graph Theory:** Basic terminologies of graphs, connected and disconnected graphs, subgraphs, paths, and cycles. complete graphs, digraphs, weighted graphs, Euler and Hamiltonian graphs, as well as trees, their properties, the concept of spanning trees, and planar graphs, along with definitions and basic results related to these topics.	11
IV	**Matrix Algebra:** Types of matrices and their algebraic operations such as addition, subtraction, and multiplication. Determinants, symmetric and skew-symmetric matrices, orthogonal matrices, the rank and inverse of a matrix, and applications of matrices in solving systems of linear equations using Cramer's Rule. Eigen values, eigenvectors, Cayley-Hamilton Theorem.	12

Text Books:

1. Kolman B., Busby R., and Ross S., *Discrete Mathematical Structures*, 6th Edition, Pearson Educatio 2015.
2. Deo Narsingh, *Graph Theory with Application to Engineering and Computer Science*, Prentice Hall India, 1979.

3. Vasishtha A. R. and Vasishtha A. K., *Matrices*, Krishna Prakashan, 2022.
4. Garg R., *Engineering Mathematics*, Khanna Book Publishing Company, 2024.
5. Garg R., *Advanced Engineering Mathematics*, Khanna Book Publishing Company, 2023.

Reference Books:

1. Grimaldi Ralph P. and Ramana B. V., *Discrete and Combinatorial Mathematics: An Applied Introduction*, 5th Edition, Pearson Education, 2007.
2. Rosen Kenneth H. and Krithivasan Kamala, *Discrete Mathematics and its Applications*, McGraw Hill, India, 2019.
3. West Douglas B., *Introduction to Graph Theory*, 2nd Edition, Pearson Education, 2015.
4. Stephen Andrilli and David Hecker, *Elementary Linear Algebra*, 4th Edition, Elsevier Science, 2010.
5. Discrete Mathematics and it's applications" by Kenneth Rosen , MC Graw Hill