Course Name	**:**	**DISCRETE STRUCTURES FOR COMPUTER SCIENCE**
Course Code	**:**	**CS1303**
Credits	**:**	**4**
L T P	**:**	**3 1 0**
Type of Course	**:**	**Department Core Course (DCC-III)**

Course Objectives:

- To develop logical thinking and its application to computer science.
- To reason mathematically about basic data types and structures (such as numbers, sets, graphs, and trees) used in computer algorithms and systems; synthesize elementary proofs, especially proofs by induction.
- To model and analyze computational processes using analytic and combinatorial methods.
- To apply principles of discrete probability to calculate probabilities and expectations of simple random processes.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**MATHEMATICAL REASONING** Mathematical reasoning, Propositions, Negation, disjunction and conjunction, Implication and Equivalence, Truth tables, Predicates, Quantifiers, Natural deduction, Rules of Inference, Methods of proofs, Resolution principle, Application to PROLOG.	**7**
2	**SET THEORY** Paradoxes in set theory, Inductive definition of sets and proof by induction, Peano postulates, Relations, Properties of relations, Equivalence Relations and partitions, Partial orderings, POSETs, Linear and well-ordered sets.	**8**
3	**FUNCTIONS** Functions; mappings, Injection and Surjections, Composition of functions, Inverse functions, Special functions, Recursive function theory.	**6**
4	**COMBINATORICS** Elementary combinatorics, Pigeonhole principle, Permutations and Combinations, Counting techniques, Recurrence relations, Solving Linear Recurrence relations, Generating functions.	**9**
5	**GRAPH THEORY** Elements of graph theory, Graph Isomorphism, Euler graph, Hamiltonian path, trees, Tree traversals, Spanning trees, Representation of relations by graphs.	**5**
6	**GROUPS, RINGS, FIELDS** Definition and elementary properties of groups, Semigroups, Monoids, Rings, Fields, Vector spaces and lattices.	**2**

7	**DISCRETE PROBABILITY** Introduction, Probability Theory, Bayes' Theorem, Expected Value and Variance, Discrete random variables.	**5**

List of Experiments: (Use Python Programming language)		**Number of Turns**
1	Print truth table of a compound statement. Example: $[(p \wedge q) \wedge r] \rightarrow (s \vee t)$	1
2	Determine whether a compound statement is valid or not.	1
3	List subsets of set {1, 2, 3, …, n} where $1 \leq n \leq 10$.	1
4	Perform various set operations on a given set such as Union, intersection, difference etc.	
5	List all selections of size 2 from the objects 1, 2, 3, 4, 5, 6. Mention scenarios such as repetition allowed or not etc. Repeat the same for selections of size 3.	1
6	List the integer solutions of a constrained linear equation. Example: $x_1 + x_2 + x_3 = 10,\ 0 \leq x_i,\ 1 \leq i \leq 3$	1
7	Write a recursive function to compute gcd of two numbers.	1
8	Based on given data, determine various properties of a relation.	
9	Implement Spanning trees.	1
10	Implement Tree traversal techniques.	1
11	Determine whether a graph is Euler graph or not.	2
12	Solve Tower of Hanoi problem.	2
13	Create Sudoku Solver.	2

Course Outcomes: At the end of the course, students will be able to:	
1	Use logical notation to define and reason about fundamental mathematical concepts such as sets, relations, functions, and integers. Analyze logical propositions via truth tables.
2	Synthesize induction hypotheses and simple induction proofs.
3	Calculate numbers of possible outcomes of elementary combinatorial processes such as permutations and combinations.
4	Apply graph theory models of data structures and state machines to solve problems of connectivity and constraint satisfaction, for example, scheduling.
5	Prove elementary properties of modular arithmetic and explain their applications in Computer Science, for example, in cryptography and hashing algorithms.
6	Calculate probabilities and discrete distributions for simple combinatorial processes; calculate expectations.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**

1	K. H. Rosen, Discrete Mathematics and applications, 7th Edition, McGraw Hill	2012
2	Seymour Lipschutz and Marc Lipson, Schaum's Outline of Discrete Mathematics, 3rd Edition	2010
3	J. L. Mott, A. Kandel, T. P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians, 2nd Edition, Pearson India	2015
4	C. L. Liu and D. P. Mohapatra, Elements of Discrete Mathematics, 4th Edition., McGraw-Hill	2012
5	C. Stein, R. L. Drysdale, K. Bogart, Discrete Mathematics for Computer Scientists, Second edition, Pearson Education Inc.	2011
6	W. K. Grassmann and J. P. Trembnlay, Logic and Discrete Mathematics, A Computer Science Perspective, Prentice Hall Inc	2007
7	M. Litvin and G. Litvin, Coding in Python and Elements of Discrete mathematics, Skylight Publishing	2019
8	A. M. Stavely, Programming and Mathematical Thinking, The New Mexico Tech Press	2014