Course handout (2024-2025) (24252)

Course Name	**:**	**Discrete Structures for Computer Science**
Course Code	**:**	**DSN 4002**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:

- To develop logical thinking and its application to computer science, vital for data analysis.
- 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 establish the mathematical foundations of data manipulation and algorithms.
- 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**
Unit 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**
Unit 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**
Unit 3	**FUNCTIONS** Functions; mappings, Injection and Surjections, Composition of functions, Inverse functions, Special functions, Recursive function theory.	**6**
Unit 4	**COMBINATORICS** Elementary combinatorics, Pigeonhole principle, Permutations and Combinations, Counting techniques, Recurrence relations, Solving Linear Recurrence relations, Generating functions, Combinatorial Optimization techniques	**8**
Unit 5	**GRAPH THEORY** Elements of graph theory, Graph Isomorphism, Euler graph, Hamiltonian path, trees, Tree traversals, Huffman coding, Spanning trees Graph Analytics for data visualization **GROUPS, RINGS, FIELDS** Definition and elementary properties of groups, Semigroups, Monoids, Rings, Fields, Vector spaces, lattices, matrices and linear transformations	**8**
Unit 6	**DISCRETE PROBABILITY** Introduction, Probability Theory, Bayes' Theorem, Expected Value and Variance, Discrete random variables, Markov chains, Entropy and Information theory	**5**

Course Outcomes: At the end of the course, students will be able to:	
1	Utilize logical notations to define and reason about fundamental mathematical concepts like sets, relations, functions, and integers, which are essential for data analysis and problem-solving.
2	Synthesize induction hypotheses and perform simple induction proofs to reason about data patterns and structures, especially in recursive algorithms and data modeling.
3	Calculate the number of possible outcomes in elementary combinatorial processes, such as permutations and combinations, which are essential for data sampling and data-driven decision-making.
4	Apply graph theory models of data structures and state machines to solve problems of connectivity and constraint satisfaction, for example, scheduling.
5	Calculate probabilities and discrete distributions for simple combinatorial processes; calculate expectations for data driven decision making

Text 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
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1.	Seymour Lipschutz and Marc Lipson, Schaum's Outline of Discrete Mathematics, 3rd Edition	2010
2.	J. L. Mott, A. Kandel, T. P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians, 2nd Edition, Pearson India	2015
3.	C. L. Liu and D. P. Mohapatra, Elements of Discrete Mathematics, 4th Edition., McGraw-Hill	2012
4.	C. Stein, R. L. Drysdale, K. Bogart, Discrete Mathematics for Computer Scientists, Second edition, Pearson Education Inc.	2011
5.	W. K. Grassmann and J. P. Trembnlay, Logic and Discrete Mathematics, A Computer Science Perspective, Prentice Hall Inc	2007
6.	M. Litvin and G. Litvin, Coding in Python and Elements of Discrete mathematics, Skylight Publishing	2019
7.	A. M. Stavely, Programming and Mathematical Thinking, The New Mexico Tech Press	2014

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1.	https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/video_galleries/video-lectures/	MIT Open Courseware
2.	https://onlinecourses.nptel.ac.in/noc20_cs82/preview	NPTEL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	1	1	-	-	-	-	2	1	-	1	-	-
CO2	3	1	3	-	1	-	-	-	1	2	-	1	1	2	-
CO3	1	2	1	3	1	2	1	1	-	1	-	2	2	1	1
CO4	2	1	3	1	1	-	-	-	-	-	1	-	2	-	-
CO5	3	2	1	1	2	-	-	-	1	1	-	-	2	1	-

1-Low, 2-Medium, 3-High

As per point 6.3 Grading System (page no. 56) of 2020-21 prospectus, the breakup of various evaluation component is as follow:

Component Particulars*	**Weightage in Percentage**
Mid Term Examination	15-25
Assignments, Quizzes (min 3), Project	30-40
End Term Examination	40-50
Total	**100**

* Uniformity in evaluation to be maintained, in case a common course is being taught by multiple instructors, in terms of evaluation and weightage.

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Component Particulars	**Weightage in Percentage**
Mid Term Examination	20
Theory Quizzes	20
End Term Examination	40
Tutorial Sheets	10
Assignment	10
Total	**100**

1. You can visit your instructor in her office from 11.00 am to 1.00 pm of all working days to discuss any topic/problems related to this subject or to clarify any doubt.
2. Final grades earned by an individual student shall be lowered as per his/her attendance (as approved by the Senate in its 80th meetings held on 9-5-2019 agenda item no. 80.14) which is given as follow:
   - If attendance is more or equal to 75% then **grade is not lowered.**
   - If attendance lies between 50% and less than 75% then grade is **lowered by ONE** level.
   - If attendance is less than 50% then grade is **lowered by TWO** level.