



KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY

Deemed to be University

Department of Mathematics

School Of Applied Sciences

Spring Semester 2023-24

Course Handout

Date: 07-12-2024

1. Course code : MA 21002
2. Course Title : Discrete Mathematics
3. L-T-P Structure : 3-1-0
4. Faculty Coordinator: Dr. Manoranajn Sahoo
5. Course Faculty : Dr. Priyanka Koner
6. Course Objectives:

The main objective of this course is to provide mathematical concepts and build up strong mathematical fundamentals to support many subjects of computer science engineering such as design and analysis of algorithms, computability theory, software engineering, computer systems, syntactical analysis, information organization and retrieval, switching theory, computer representation of discrete structures and programming languages etc.

7. Course (learning) Outcomes:

After successfully completing the course, the students will be able to

- CO1. **formulate** sentences in natural language into mathematical statements and **understand** predicate and quantifiers, rules of inference and prove results by principle of mathematical induction.
- CO2. **apply** the principles of inclusion and exclusion of sets, concept of relations and functions and solve related problems.
- CO3. **develop an ability to** get partition of sets, partial ordering relation, Hasse diagram and Lattice.
- CO4. **Analyze** problems on recurrence relations by substitution and method of generating functions and know a powerful method of counting,
- CO5. **Understand** the concept and some properties of algebraic structures and **use** them in coding.
- CO 6: **Apply** Graph theory in related areas like Syntactic analysis, Fault detection and diagnosis in computers, Scheduling problems and Minimal-path problems, network flow problems.

8. Course Contents

Logic: (12 Hrs)

Proposition, Truth values, Connectives, Logical equivalence of compound statement (using truth table & without truth table), Rules of Inference, Predicates and Quantifiers, Methods of Induction.

Set, Relation & Function: (17 Hrs)

Set, Operations on set, Principles of Inclusion and Exclusion, Relation and its representations through matrices and graphs, Types of relations, Properties on Binary Relation, Closures of relation, Equivalence relation and Partition of sets, Partial ordering relation, Hasse diagram, Lattice, definition of function, Injection, Surjection, Bijection, Permutation functions.

Recurrence Relation and their solutions: (5 Hrs)

Discrete numeric function, Generating Function, Concept of Linear Recurrence Relation with constant coefficients and its solution (Substitution Method and by using generating function).

Algebraic structure: (11 Hrs)

Introduction to Algebraic structures, Semi group, monoid, Group, Abelian group. Properties of groups, Cyclic groups and its generator, Sub group, cosets, Normal subgroup, Lagrange's Theorem, Homomorphism and Isomorphism, Ring, Integral domain, Field (Definition with examples)

Graph Theory (11Hrs)

Basic Terminology, Adjacency and incident matrices, Graph isomorphic test, Paths, Circuit, Eulerian path and Eulerian circuit, Hamiltonian path and circuit, Shortest path algorithms (Dijkstra), Tree, Rooted Tree, Binary Tree, Spanning tree, Minimal spanning tree (MST) algorithms (Prim's & Kruskal's Algorithms), and Planar and nonplanar graphs.

9. Text Book:

1. Rosen, K. H. *Discrete Mathematics and its Applications* (7th Edition). New Delhi: Mc Graw Hill Publication. ISBN-13: 978-81-953536-7-5.

10. Reference Book:

1. Liu, C. L. and Mohapatra, D. P. (2013) *Elements of Discrete Mathematics. A computer oriented approach* (4th Edition). Tata Mc Graw Hill Publication
2. Nanda, S. (2022) *Discrete Mathematics*, Allied Publisher Pvt. Ltd.
3. Douglas B. West, (2002), *Introduction to Graph Theory* (2nd Edition), Pearson.
4. Iyengar et al., (2020) *Discrete Mathematics* Vikas Publishing House Pvt. Ltd.

11. Lesson plan and active learning activities

Class No.	TOPICS	CO Mapping
	CHPATER-I (LOGIC: Propositional & Predicate Calculus)-12hrs	
1.	Introduction to the course, Course Objective, Course Outcome	
2.	Proposition, Truth values, Truth Table, Connectives and compound propositions.	CO1
3.	Logical equivalence of compound propositions, Tautology, Contradiction,	CO1
4.	Rules of inferences	CO1
5.	Arguments and conclusions	CO1
6.	Tutorial / Doubt Clearing	CO1
7.	Predicates and Quantifiers, Quantifiers with Restricted Domains,	CO1
8.	Precedence of Quantifiers, Logical Equivalences Involving Quantifiers	CO1
9.	Rules of Inference for Quantified Statements	CO1
10.	Tutorial / Doubt clearing	CO1
11.	Method of Induction	CO1
12.	Method of strong Induction	CO1
	Assignment / Class test	CO1
	CHPATER-II (Set, Relation and Function)-17hrs	
13.	Sets set operations, The Size of a Set, Principle of Inclusion-Exclusion	CO2
14.	Cartesian Products, binary relations, basic Properties of Relations	CO2
15.	representation of Binary Relations (Matrix and diagraph)	CO2
16.	Tutorial / Doubt Clearing	CO2
17.	Closures of Relations (Reflexive, symmetric and transitive)	CO2
18.	Transitive Closures by using matrices. Warshall's Algorithm	CO2
19.	Equivalence relation and	CO3
20.	Equivalence Classes and Partitions	CO3
21.	Tutorial / Doubt Clearing	CO3
22.	Partial Ordering Relation, POSET	CO3
23.	Hasse Diagram, Maximal and Minimal Elements	CO3
24.	Lattices and their Properties	CO3
25.	Tutorial / Doubt Clearing	CO3
26.	Functions, injections, Surjections, Bijections, Inverse Functions and composition of functions	CO3
27.	Inverse Functions and composition of functions	CO3
28.	Permutation function and its properties	CO3
29.	Tutorial / Doubt Clearing ,	CO3
	Assignment / Class test	CO2, CO3
	MID SEMESTER EXAMINATION	
	CHPATER-III (Linear Recurrence Relations with Constant Coefficients)-05hrs	

30	Discrete numeric function: Sequences, Generating Function	CO4
31	Linear Recurrence Relations with Constant Coefficients	CO4
32	Solution of Recurrence Relation: Substitution Method	CO4
33	Solution of Recurrence Relation: Generating Function	CO4
34	Tutorial / Doubt Clearing	CO4
	CHPATER-IV (Abstract Algebra and Coding Theory)-11hrs	
35	Binary Operation and properties, Algebraic Structures: semi group, monoid	CO5
36	Group and group axioms	CO5
37	Properties of groups	CO5
38	Tutorial / Doubt Clearing	CO5
39	Subgroup and properties	CO5
40	Cosets and Lagrange's Theorem	CO5
41	Normal Subgroups	CO5
42	Tutorial / Doubt Clearing	CO5
43	Group Homomorphism	CO5
44	Ring, Integral domain and field	CO5
45	Tutorial / Doubt Clearing,	CO5
	Assignment / Class test	CO4, CO5
	CHPATER-V (Graph Theory)-11hrs	
46	Basic Terminologies, walk, trail, path circuit. Adjacency and incident matrices, Graph Isomorphism	CO6
47	Eulerian path and Eulerian circuit, Hamiltonian path and circuit, Eulerian and Hamiltonian Graphs	CO6
48	Connected Graph, cut sets, vertex connectivity, edge connectivity and relation	CO6
49	Shortest Path Algorithms (Dijkstra)	CO6
50	Tutorial / Doubt Clearing	CO6
51	Tree, Rooted Tree, Binary Tree, Spanning tree, Minimal spanning tree	CO6
52	MST algorithms (Prim's & Kruskal's Algorithms),	CO6
53	Planar and nonplanar graphs, Kuratowski graph, Euler formula.	CO6
54	Graph Colouring, Chromatic numbers	CO6
55	Five colour and four colour theorems	CO6
56	Tutorial / Doubt Clearing,	CO6
57	Doubt Clearing,	
58	Previous year Question Paper discussion	
59	Previous year Question Paper discussion	
60	Doubt Clearing	
	END SEMESTER EXAMINATION	

12. Assessment components:

Sl. No.	Assessment Component	Duration	Weightage / Marks	Nature of the Component
1	Mid Semester Examination	90 min	20	Closed Book
2	End Semester Examination	3 Hours	50	Closed Book
3	Problem Solving	1 week	10	Open Book
4	Quiz Test	20min	15	Closed Book
5	Critical Thinking	15 days	5	Open Book

13. Activity Calendar:

Sl. No.	Type of Activity/ Nature of the Component	Marks	Schedule for Activities	Duration For Submission	Publication of result	Mapping with COs
1	Assignment-I (Open Book)	5	1 st Week Of January 2025	1 week	2 nd Week Of January 2025	CO1, CO2
2	Quiz -I (Closed Book)	5	3 rd Week Of January 2025	30min	Same day	CO1, CO2
3	Assignment-II (Open Book)	5	1 st Week Of February2025	1 week	2 nd Week Of February2025	CO3, CO4
4	Quiz -II (Closed Book)	5	1 st Week Of March 2025	30 mins	Same day	CO3, CO4
5	Critical Thinking (Open Book)	5	3 rd Week Of March 2025	1 week	4 th Week Of March 2025	CO5, CO6
6	Quiz -III (Closed Book)	5	1 st Week Of April 2025	30min	Same day	CO5, CO6

14. Attendance: Every student is expected to be regular (in attendance) in all lecture classes, tutorials, tests, quizzes, seminars etc and in fulfilling all tasks assigned to him / her. Attendance will be recorded and 75% attendance is compulsory.

15. Makeup:

- 1) No make-up examination will be scheduled for the mid semester examination. However, official permission to take a make-up examination will be given under exceptional circumstances such as admission in a hospital due to illness / injury, calamity in the family at the time of examination.
- 2) A student who misses a mid-semester examination because of extenuating circumstances such as admission in a hospital due to illness / injury, calamity in the family may apply in writing via an application form with supporting document(s) and medical certificate to the Dean of the School for a make-up examination.
- 3) Applications should be made within five working days after the missed examination.

16. Discussion of Mid Semester performance: Performance of the mid semester examination will be discussed in the class room

17. Pre-end semester total marks: *Please see the SAP portal link:*

18. Course Management System: SAP Portal is a software system designed to facilitate teachers in the management (instructional content, assessment and documentation) of the courses for their students, both teachers and students can monitor the system. Though usually considered as a tool and often used to complement the face-to-face classroom.

19. Chamber consultation hour for doubts clarification: Room No. 503, 5th floor, D Block, Campus 3.

20. Notices: All notices regarding the course will be displayed only on the School of Applied Sciences (Computer/Electronics Engineering) notice board.

**Course Coordinator
(Dr. Manoranjan Sahoo)**