Course Handout

Institute/School Name	Chitkara University Institute of Engineering & Technology		
Department Name	Department of Computer Science & Engineering**(Artificial Intelligence)**		
Programme Name	Bachelor of Engineering- Computer Science & Engineering **(Artificial Intelligence and Machine Learning)**		
Course Name	Discrete Mathematics	Session	July-Dec, 2025
Course Code	24APS3103	Semester/Batch	3rd/2024
L-T-P(Per Week)	2-0-0	Course Credits	2
Pre-requisite	Basic knowledge of algebra and number system	NHEQF Level	5
Course Coordinator	Dr. Renu Bala	SDG Number	4

1. Objectives of the Course

The course provides the ability to develop the mathematical foundations, abstraction and formalization of reasoning for the problems related to Artificial Intelligence and Machine Learning to arrive at substantiated conclusions. The main objectives of the course are:

- To understand the theory and techniques of graphs, trees, and algebraic systems.
- To apply the knowledge and skills obtained to investigate and solve a variety of discrete mathematical problems.
- To communicate mathematical ideas and to make effective use of appropriate technology.
- To comprehend discrete mathematics and their relevance within the context of computer science, in the areas of data structures and algorithms.
- To apply discrete structures into other computing problems such as formal specification, verification, databases, and cryptography.

2. Course Learning Outcomes (CLOs)

Students should be able to:

	CLOs	Program Outcomes (PO)	NHEQF Level Descriptor	No. of Lectures
CLO01	Apply the knowledge to investigate and solve a variety of live problems related to Sets, Relations and functions.	PO1, PO2, PSO1	Q1, Q2	7
CLO02	Solve real life problems by applying discrete structures into computing problems.	PO1, PO2, PSO2, PSO3	Q3	5
CLO03	Comprehend Graph Theory and its relevance within the context of computer science and find solutions of live problems related to shortest path etc.	PO1, PO2, PO3, PSO2, PSO3	Q2, Q3	18
Total Contact Hours				**30**

CLO-PO-PSO Mapping grid |Program Outcomes (POs) and Program Specific Outcomes (PSO) are available as a part of Academic Program Guide

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Type of Assessment's
CLO01	H	H											M			Formative/Summative
CLO02	H	H												M	H	Formative/Summative
CLO03	H	M	H											M	H	Formative/Summative

*H=High, M=Medium, L=Low

3. Recommended Books:

B01: Elements of Discrete Mathematics; C.L.Liu, McGraw-Hill, 4th Edition.
B02: Discrete Mathematics; Babu Ram, Pearson Education India, 1st Edition.
B03: Discrete Mathematics; Lipschutz/Lipson, Schaum Series, 2nd Edition, TMH.
B04: Discrete Mathematics and its Applications; Kenneth H. Rosen, McGraw- Hill, 7th Edition.
B05: Discrete Structures; C.P. Gandhi, Laxmi Publications Pvt Ltd, 4th Edition.
B06: Discrete Mathematics; R.C. Joshi, New Academic Publications, 13th Edition.

4. Other readings and relevant websites:

Serial No	Link of Journals, Magazines, websites and Research Papers
1.	http://download.nos.org/srsec311new/L.No.15-A.pdf
2.	http://faculty.simpson.edu/lydia.sinapova/www/cmsc180/LN180_Johnsonbaugh-07/L17EquivalenceRel.htm
3.	http://web.cs.wpi.edu/~cs504/s00m/notes/recurrence/solve/step2/step2.html
4.	http://www.iep.utm.edu/prop-log/
5.	http://plato.stanford.edu/entries/boolalg-math/
6.	http://www.hamilton.ie/ollie/Downloads/Graph.pdf

5. Recommended Tools and Platforms

MATLAB

6. Course Plan: Theory

Lecture Number	Topics
1-4	Introducing to Sets: Properties & Operations on Sets, Subsets, Power set, Inclusion-Exclusion Principle, Principle of Duality, Cartesian Product of Sets, Partition of sets, Minsets, Maxsets. Introduction to Relations: Types of Relations, Pictorial & Matrix Representation of Relation, Inverse Relation, Composition of Relations, Properties of Relations.
5	Equivalence Relation, Partial Order Relation
6-7	Introduction to Functions: Types of Functions, Domain & Range of Functions, Inverse Functions, Injective, Surjective, Bijective & Composition of Functions, Recursive Functions.
8	Permutations & Combinations, Pigeon Hole Principles.
9-10	Recurrence Relation: Homogeneous and Non-Homogeneous Recurrence Relations with

		Constant Coefficients.
11-12		Characteristic Polynomial & Introduction to Generating Functions: Methods of Generating Functions.
Sessional Test – 1 (Lecture 1 to 12)		
13-14		Graph Theory: Introduction to Graphs & Sub Graphs. Directed & Undirected Graph, Order & Size of Graph, Degree of Vertex, Source, Sink, Eccentricity, Trail, Walk, Path,
15-16		Distance, Diameter, Cycle, Wheel, Multi Graph, Planar Graph, Pseudo graph,
17-18		Weighted Graph, Regular, Complete and Traversable Graph. Isomorphism of Graphs, Sub Graphs, Complement of Graph, Adjacency Matrix, Adjacency List, Incidence Matrix,
19-20		Complete Bipartite Graph & Spanning Graph, Cut Vertex, Cut Edge, Region, Eulerian & Hamiltonian Graphs.
21-23		Euler's Formula & its Applications: Traveling Salesman Problem, Konigsberg Bridge Problem, Chromatic Number & Graph Coloring by Welsh Powell Algorithm.
24-26		Trees: Binary Trees, Traversing Binary Trees, Rooted & Spanning Trees, Algebraic Expression Trees, Depth-First Search Algorithm, Breadth-First Search Algorithm.
Sessional Test – 2 (Lecture 13 to 26)		
27-30		Shortest Path Algorithm: Kruskal's Algorithm, Dijkstra's Algorithm, Prim's Algorithm.
END TERM –FULL SYLLABUS		

7. **Delivery/Instructional Resources**

   Theory Plan:

Lect. No.	Topics	CLO	Book No, CH No, Page No	TLM	ALM	Web References	Audio-Video
1-2	Introducing to Sets: Properties & Operations on Sets, Subsets, Power set, Inclusion-Exclusion Principle, Principle of Duality, Cartesian Product of Sets, Partition of sets, Minsets, Maxsets.	CLO01	B05 CH 1, Page no 1-49, B06, CH-5, Page No 196-229	Lecture	Think/ pair /share Quiz/T est Questi ons	https://www .cs.cornell.e du/~rafael/d iscmath.pdf	https://nptel.a c.in/courses/1 06106183
3-5	Introduction to Relations: Types of Relations, Pictorial & Matrix Representation of Relation, Inverse Relation, Composition of Relations, Properties of Relations, Equivalence Relation, Partial Order Relation	CLO01	B05 CH 2, Page no 50-54, B06 CH-6, Page No 230-273	Lecture	Quiz/ Test Questi ons	https://www .cs.cornell.e du/~rafael/d iscmath.pdf	https://nptel.a c.in/courses/1 06106183
6-7	Introduction to Functions: Types of Functions, Domain & Range of Functions, Inverse Functions, Injective, Surjective, Bijective & Composition of Functions, Recursive Functions.	CLO01 , CLO02	B05 CH-3, Page No 90-95, B06, CH-7, Page No 274-312	Lecture, Question ing	Quiz/ test Questi ons	https://www .cs.cornell.e du/~rafael/d iscmath.pdf	https://nptel.a c.in/courses/1 06106183
8	Permutations & Combinations, Pigeon	CLO02	B05, CH- 5, Page No	Lecture, Discussi	Quiz/ test	https://www	https://nptel.a

	Hole Principle		147-155 B06, CH 8, Page No 313-346	on	Questions	.cs.cornell.edu/~rafael/discmath.pdf	c.in/courses/106106183
9-10	Recurrence Relation: Homogeneous and Non-Homogeneous Recurrence Relations	CLO02	B05, CH-7,Page No 180-183, B06, CH-9, Page No 347-368	Lecture, Questioning	Quiz/ test Questions	https://www.cs.cornell.edu/~rafael/discmath.pdf	https://nptel.ac.in/courses/106106183 https://nptel.ac.in/courses/106105192
11-12	Characteristic Polynomial & Introduction to Generating Functions: Methods of Generating Functions.	CLO02	B05, CH-7, Page No 205-207 B06, CH-9, Page No 369-379	Lecture, Demonstration	Quiz/ test Questions	https://www.cs.cornell.edu/~rafael/discmath.pdf	https://nptel.ac.in/courses/106106183
13-14	Graph Theory: Introduction to Graphs & Sub Graphs. Directed & Undirected Graph, Order & Size of Graph, Degree of Vertex, Source, Sink, Eccentricity, Trail, Walk, Path	CLO03	B05, CH-11, Page No 447-452 B06, CH- 10, Page No 380-382	Lecture	Quiz/ test Questions	https://www.britannica.com/topic/graph-theory	https://nptel.ac.in/courses/111106102
15-16	Distance, Diameter, Cycle, Wheel, Multi Graph, Planar Graph, Pseudo graph,	CLO03	B05, CH-11, Page No 500	Lecture	Quiz/ test Questions	https://www.britannica.com/topic/graph-theory	https://nptel.ac.in/courses/111106102
17-18	Weighted Graph, Regular, Complete and Traversable Graph. Isomorphism of Graphs, Sub Graphs, Complement of Graph, Adjacency Matrix, Adjacency List, Incidence Matrix	CLO03	B05, CH-11, Page No 447-493	Lecture	Quiz/ test Questions	https://www.cs.cornell.edu/~rafael/discmath.pdf	https://nptel.ac.in/courses/111106102
19-20	Complete Bipartite Graph & Spanning Graph, Cut Vertex, Cut Edge, Region, Eulerian & Hamiltonian Graphs.	CLO03	B05, CH-11, Page No 461-492	Lecture	Quiz/ test Questions	https://www.cs.cornell.edu/~rafael/discmath.pdf	https://nptel.ac.in/courses/111106102
21-23	Euler's Formula & its Applications: Traveling Salesman Problem, Konigsberg Bridge Problem, Chromatic Number & Graph Coloring by Welsh Powell Algorithm.	CLO03	B06, CH-10, Page No 432-452	Lecture	Quiz/ test Questions	https://discrete.openmathbooks.org/more/mdm/sec_planar.html	https://nptel.ac.in/courses/111106102
24-26	Trees: Binary Trees, Traversing Binary Trees, Rooted & Spanning Trees, Algebraic Expression Trees, Depth-First Search Algorithm, Breadth-First Search Algorithm.	CLO03	B05, CH-12, Page No 525-545	Lecture	Quiz/ test Questions	https://discrete.openmathbooks.org/dmoi3/sec_trees.html	https://nptel.ac.in/courses/106106183

| 27-30 | Shortest Path Algorithm: Kruskal's Algorithm, Dijkstra's Algorithm, Prim's Algorithm. | CLO03 | B05, CH-11, Page No 517 B05, CH-12, Page No 550 B06, CH-10, Page No 455-457 | Lecture | Quiz/ test Questions | https://www.cs.cornell.edu/~rafael/discmath.pdf | https://nptel.ac.in/courses/106106183 |

8. Remedial Classes

After every Sessional Test, different types of learners will be identified, and special discussions will be planned and scheduled accordingly for the slow learners.

9. Self-Learning

Assignments to promote self-learning, survey of contents from multiple sources.

S. No	Topics	CLO	ALM	References/MOOCS
1	Use of Recurrence relation in Data Structures and Dynamic Programming problems	CLO01, CLO02	Think/pair/share	https://www.youtube.com/watch?v=rgGq6sELoZc&pp=ygUVI3JlY3Vyc2l2ZXByYb2dyYW1taW5n
2	Applications of Shortest path Algorithm in real life.	CLO03	Think/pair/share	https://www.youtube.com/watch?v=C4FOwaLR-h8

10. Delivery Details of Content Beyond Syllabus

Content beyond the syllabus covered (if any) should be delivered to all students that would be planned, and schedule notified accordingly.

S. No.	Advanced Topics, Additional Reading, Research papers and any	CLO	POs	ALM	References/MOOCS
1	Advanced Graph Theory	CLO03	PO1, PO2, PO3 PO11	Think/Pair/Share	https://onlinecourses.nptel.ac.in/noc21_cs48/preview

11. Evaluation Scheme & Components:

Assessment Type	Evaluation Component	Type of Component	No. of Assessments	% Weightage of Component	Max. Marks	Mode of Assessment	CLO
Summative	Component 2	Sessional Tests	02*	40%	30	Offline	CLO01, CLO02, CLO03
Summative	Component 3	End Term	01**	60%	60	Offline	CLO01, CLO02, CLO03
Total				**100%**			

All STs are mandatory. Each ST will be given the weightage of 20%.
**To appear for the End Term Exam, attendance must be at least 75%.*

12. Syllabus of the Course:

Subject: Discrete Mathematics		Course Code: 24APS3103	
S. No.	**Topic (s)**	**No. of Lectures**	**Weightage %**
1-7	Introducing to Sets: Properties & Operations on Sets, Subsets, Power set, Inclusion-Exclusion Principle, Principle of Duality, Cartesian Product of Sets, Partition of sets, Minsets, Maxsets. Introduction to Relations: Types of Relations, Pictorial & Matrix Representation of Relation, Inverse Relation, Composition of Relations, Properties of Relations, Equivalence Relation, Partial Order Relation Introduction to Functions: Types of Functions, Domain & Range of Functions, Inverse Functions, Injective, Surjective, Bijective & Composition of Functions, Recursive Functions.	7	23%
8-12	Permutations & Combinations, Pigeon Hole Principle, Recurrence Relation : Homogeneous and Non-Homogeneous Recurrence Relations with Constant Coefficients. Characteristic Polynomial & Introduction to Generating Functions: Methods of Generating Functions.	5	16%
13-20	Graph Theory: Introduction to Graphs & Sub Graphs. Directed & Undirected Graph, Order & Size of Graph, Degree of Vertex, Source, Sink, Eccentricity, Trail, Walk, Path, Distance, Diameter, Cycle, Wheel, Multi Graph, Planar Graph, Pseudo graph, Weighted Graph, Regular, Complete and Traversable Graph. Isomorphism of Graphs, Sub Graphs, Complement of Graph, Adjacency Matrix, Adjacency List, Incidence Matrix, Complete Bipartite Graph & Spanning Graph, Cut Vertex, Cut Edge, Region, Eulerian & Hamiltonian Graphs.	8	26%
21-30	Euler's Formula & its Applications: Traveling Salesman Problem, Konigsberg Bridge Problem, Chromatic Number & Graph Coloring by Welsh Powell Algorithm. Trees: Binary Trees, Traversing Binary Trees, Rooted & Spanning Trees, Algebraic Expression Trees, Depth-First Search Algorithm, Breadth-First Search Algorithm. Shortest Path Algorithm: Kruskal's Algorithm, Dijkstra's Algorithm, Prim's Algorithm	10	35%

13. Academic Integrity Policy:

Education at Chitkara University builds on the principle that excellence requires freedom where Honesty and integrity are its prerequisites. Academic honesty in the advancement of knowledge requires that all students and Faculty respect the integrity of one another's work and recognize the importance of acknowledging and safeguarding intellectual property. Any breach of the same will be tantamount to severe academic penalties.

This Document is approved by:

Designation	Name	Signature
Course Coordinator	Dr. Renu Bala	
Head-Academic Delivery	Dr. Reetu Malhotra	
Assistant Dean	Dr. Mohit Kumar Kakkar	
Date (DD/MM/YYYY)	27/06/2025	