25CAMD203: Discrete Mathematics and Statistical Methods

w. e. f. Academic Year:	**2026-27**
Semester:	**B.E. 3rd (Computer Engineering/ Computer Science and Engineering/ Information Technology)**
Category of the Course:	**PCC**
Prerequisite:	Basic knowledge of mathematics requires as sets, relations, functions, algebraic manipulation and equations, Logic, graphs and logical reasoning, and statistics.
Rationale:	This course provides a strong foundation in discrete mathematical structures and statistical methods, which are essential for various fields like computer science, engineering, and data analysis. Topics such as lattices, algebraic structures, and graph theory develop analytical and problem-solving skills, while statistics supports data interpretation and decision-making. The course prepares students for advanced study and real-world applications in modelling, optimization, and computation.

Course Outcomes:

After Completion of the Course, Student will able to:

CO No.	Course Outcome	RBT Level
CO1	Apply fundamental concepts of set theory, relations, and lattices to analyze ordered structures and solve related problems.	Apply
CO2	Analyze algebraic structures such as groups, rings, and fields and interpret their properties in mathematical systems.	Analyze
CO3	Apply graph theory concepts to model and solve real-world problems involving networks and connectivity.	Apply
CO4	Analyze and interpret data using descriptive statistics and sampling techniques for informed decision-making.	Analyze
CO5	Apply correlation and regression techniques to study relationships between variables and perform predictive analysis for informed decision-making, industrial innovation, and sustainable economic development.	Apply

Teaching and Evaluation Scheme:

Teaching Scheme					Examination Scheme				
L	**T**	**P**	**C**	**Hrs/Week**	**IE**	**EE**	**CIA**	**Practical**	**Total Marks**
3	1	2	5	6	40	60	30	20	150

IE: Internal Evaluation EE: External Exam (End Semester)

CIA: Continuous Internal Assessment Practical: Practical Exam (End Semester)

Detailed Syllabus:

Unit No.	Topic	Hrs.	Marks % Weightage (Approx.)
UNIT: 1	**Lattices:** Basic Concepts of Set Theory: Definitions, Inclusion, Equality of Sets, Cartesian product, The Power Set, some operations on Sets, Relation, Partial Ordering Relation, Equivalence Relation Hasse, Diagrams, Lattices as POSET, properties of lattices, bounds of lattices, bounded lattice, distributive lattice, complemented lattices. Strengthens mathematical foundations and logical reasoning skills. Supports structured problem-solving used in computational systems and decision models.	05	11
UNIT: 2	**Algebraic Structures:** Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Sub-group, Congruence Relation, Permutation Groups, cyclic groups, Normal Subgroups, Quotient group, homomorphisms Algebraic Structures with two Binary Operation: Rings, Integral Domain and Fields (definition and properties). Enhances abstract mathematical thinking and analytical skills. Provides a foundation for cryptography, coding theory, and computational applications.	10	22
UNIT: 3	**Graphs:** Introduction of Graph, Directed graph, Undirected graph with examples;, Loops (sling), Parallel edges, Multi-graph Pseudo graph, Simple graph, Weighted graphs, Isolated nodes, Null graph, Isomorphic graphs, Degree of nodes, examples; Subgraphs: Definition, examples; Path: Definition, Paths of a given graph, length of path, examples; Simple path (edge simple), elementary path (node simple), examples; Cycle (circuit), elementary cycle, examples; Eulerian and Hamiltonian Walks, Planar Graphs, Graph coloring: coloring maps, coloring Vertices, Colorings Edges. Supports network design, optimization, and communication systems. Helps in transportation planning, traffic systems, and smart city infrastructure.	08	18
UNIT: 4	**Data Handling & Descriptive Statistics**: Types of data (categorical, numerical); data presentation (tables, histograms – conceptual); measures of central tendency (mean, median, mode); measures of dispersion (range, variance, standard deviation); interpretation of results (focus on intuition, not just formulas). Develops statistical literacy and analytical thinking Supports data-driven decision-making in professional and business environments.	08	18

UNIT: 5	**Sampling & Estimation**: Sampling methods (random, stratified – concept only); population vs sample; estimation (point estimation only); introduction to sampling error (conceptual understanding. Improves decision-making using accurate data sampling methods. Supports research and innovation through reliable statistical estimation.	08	18
UNIT: 6	**Correlation & Regression**: Correlation, Types of Correlations, Methods of Studying Correlation, Scatter Diagram, Simple Graph, Karl Pearson's Coefficient of Correlation, Rank Correlation, Regression, Types of Regression, Lines of Regression, Regression Coefficients. Helps in business forecasting and decision-making using data analysis. Supports predictive modeling and analytical problem-solving in industry.	06	13

List of Tutorial and /or Practical:

Sr No	Topic	Hrs
1	Set Operations Implementation: Perform union, intersection, difference, symmetric difference, Cartesian product, and power set using Python.	2
2	Relations and Their Properties: Given a relation, check properties: reflexive, symmetric, transitive, and equivalence relation.	2
3	Partial Order and Hasse Diagram: Represent a partially ordered set (POSET) and generate a simple Hasse diagram using Python.	2
4	Binary Operation Checker: Define a binary operation and verify closure, associativity (limited cases), and identity element.	2
5	Group Property Verification: Check group properties including inverse and identity for a given set and operation.	2
6	Subgroup and Cyclic Group: Identify subgroups and generate cyclic groups from a given group.	2
7	Homomorphism Checker: Verify whether a given mapping between algebraic structures is a homomorphism.	2
8	Graph Representation: Represent directed and undirected graphs using adjacency matrix and adjacency list.	2
9	Degree of Nodes: Compute degree of each vertex in a graph and analyze graph properties (Hand-Shaking Lemma).	2
10	Graph Properties: Detect cycles and check Eulerian/ Hamiltonian graph conditions for a given graph.	2
11	Descriptive Statistics: Compute mean, median, mode, variance, and standard deviation for a dataset.	2
12	Data Visualization: Create frequency tables and histograms using Python and interpret results.	2
13	Sampling Techniques: Perform random sampling and compare sample statistics with population statistics.	2
14	Correlation Analysis: Implement Karl Pearson's coefficient and rank correlation to study relationships between variables.	2

15	Linear Regression: Perform simple linear regression and plot regression line for prediction.	2

Learning Resources:

1 Text Books

- Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw-Hill Education, Latest Edition.
- J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Education.

2 Reference Books

- C. L. Liu and D. P. Mohapatra, Elements of Discrete Mathematics, McGraw-Hill Education.
- Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall.
- J. D. Ullman, Principles of Database and Knowledge-Based Systems, Computer Science Press.

3 Online References

- NPTEL – Discrete Mathematics / Graph Theory (IIT Lectures)
- MIT Open Courseware – Mathematics for Computer Science.
- Khan Academy – Statistics and Probability

Teaching Learning Method

- Lecture-based teaching-learning
- Group-teaching and learning
- Individual learning/self-study
- Inquiry-based learning
- Kinesthetic learning / Practicals
- Game-based learning
- Expeditionary learning (Real-world problems)
- Technology-based Learning
- Peer Teaching
- Learning through problem-solving

Course Outcomes Mapping:

CO No.	Course Outcome (CO)	POs/ PSOs Mapped	Cognitive Level (RBT)	Knowledge Category	Class Sessions (Lecture)
CO1	Apply fundamental concepts of set theory, relations, and lattices to analyze ordered structures and solve problems.	PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2	Apply	Conceptual (K2)	5

CO2	Analyze algebraic structures such as groups, rings, and fields and interpret their properties.	PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2	Analyze	Conceptual (K2)	10
CO3	Apply graph theory concepts to solve engineering-related network problems.	PO1, PO2, PO3, PO4, PO5, PO8, PO11, PSO1, PSO2	Apply	Procedural (K3)	8
CO4	Analyze and interpret data using statistical methods and sampling techniques.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO11, PSO1, PSO2	Analyze	Procedural (K3)	8
CO5	Apply correlation and regression techniques to study relationships between variables and perform predictive analysis for informed decision-making, industrial innovation, and sustainable economic development.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO11, PSO1, PSO2	Apply	Procedural (K3)	14

Mapping of COs with POs & PSOs:

CO	PO											PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO1	3	2	1	1	1	-	-	-	-	-	1	3	2
CO2	3	3	1	2	1	-	-	-	-	-	1	3	2
CO3	3	3	2	2	2	-	-	1	-	-	1	2	3
CO4	2	3	1	3	2	1	-	-	1	-	1	3	3
CO5	2	3	2	3	2	1	-	-	1	-	1	3	3

3: High, 2: Medium, 1: Low

Sustainable Development Goals (SDG) Integration

This course integrates principles of sustainable engineering by emphasizing efficient mechanism design, reduced material consumption, and applications in sustainable infrastructure and transportation systems aligned with SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), and SDG 11 (Sustainable Cities and Communities).

SDG Mapping with Course Outcomes

CO	Course Outcome	Relevant SDGs	Justification
CO1	Apply fundamental concepts of set theory, relations, and lattices to analyze ordered structures and solve related problems.	SDG 4 – Quality Education SDG 9 – Industry, Innovation and Infrastructure	Strengthens mathematical reasoning and logical problem-solving skills required for computational systems and technological innovation.
CO2	Analyze algebraic structures such as groups, rings, and fields and interpret their properties in mathematical systems.	SDG 4 – Quality Education SDG 9 – Industry, Innovation and Infrastructure	Supports abstract thinking and provides the mathematical foundation for applications such as cryptography, coding theory, and computing systems.
CO3	Apply graph theory concepts to model and solve real-world problems involving networks and connectivity.	SDG 9 – Industry, Innovation and Infrastructure SDG 11 – Sustainable Cities and Communities	Helps in network optimization, communication systems, transport planning, and smart infrastructure development.
CO4	Analyze and interpret data using descriptive statistics and sampling techniques for informed decision-making.	SDG 4 – Quality Education SDG 8 – Decent Work and Economic Growth	Enhances data literacy and supports informed decisions in business, research, and professional environments.
CO5	Apply correlation and regression techniques to study relationships between variables and perform predictive analysis for informed decision-making, industrial innovation, and sustainable economic development.	SDG 8 – Decent Work and Economic Growth SDG 9 – Industry, Innovation and Infrastructure	Supports forecasting, business analytics, industrial decision-making, and predictive modeling for sustainable development.