Shyama Prasad Mukherji College Teaching Plan

**Course and Year: B.A (Prog.) - IIIrd yr. (July to December: 2022-2023) Semester: V**

**Taught individually or shared: Shared**

**Faculty:Dr. Kundan Mishra, Ms.Monika**

**DSE-1 (ii): Discrete Mathematics**

**Total Marks:** 100 (Theory: 75 and Internal Assessment: 25)

**Workload:** 5 Lectures, 1 Tutorial (per week) **Credits:** 6 (5+1)

**Duration:** 14 Weeks (70 Hrs.) **Examination:** 3 Hours.

**Course Objectives:** Discrete mathematics is the study of mathematical structures that are fundamentally discrete rather than continuous. The mathematics of modern computer science is built almost entirely on discrete math, in particular Boolean algebra and graph theory. The aim ofthis course is to make the students aware of the fundamentals of lattices, Boolean algebra and graph theory.

**Course Learning Outcomes:** The course will enable the students to understand:

1. Learn about partial ordering of sets and various types of lattices.
2. Learn about Boolean algebra and switching circuits with Karnaugh maps.
3. Know about basics of graph theory and four color map problem.

# Unit 1: Partial Ordering

Definition, Examples and properties of posets, Maps between posets, Algebraic lattice, Lattice asa poset, Duality principle, Sublattice, Hasse diagrams; Products and homomorphisms of lattices, Distributive lattice, Complemented lattice.

# Unit 2: Boolean Algebra and Switching Circuits

Boolean algebra, Boolean polynomial, CN form, DN form; Simplification of Boolean polynomials, Karnaugh diagram; Switching circuits and its applications, Finding CN form and DN form.

# Unit 3: Graph Theory

Graphs, Subgraph, Complete graph, Bipartite graph, Degree sequence, Euler’s theorem for sum of degrees of all vertices, Eulerian circuit, Seven bridge problem, Hamiltonian cycle, Adjacency matrix, Dijkstra’s shortest path algorithm (improved version), Digraphs; Definitions and examples of tree and spanning tree, Kruskal’s algorithm to find the minimum spanning tree; Planar graphs, Coloring of a graph and chromatic number.

# Reference:

* 1. Rosen, Kenneth H. (2011). *Discrete Mathematics and its Applications with Combinatorics and Graph Theory* (7th ed.). McGraw-Hill Education Private Limited. Special Indian Edition.

# Additional Readings:

1. Goodaire, Edgar G. & Parmenter, Michael M. (2011). *Discrete Mathematics with GraphTheory*

(3rd ed.). Pearson Education (Singapore) Pvt. Ltd. Indian Reprint.

1. Hunter, David J. (2017). *Essentials of Discrete Mathematics* (3rd ed.). Jones & Bartlett Learning, LLC.
2. Lidl, Rudolf & Pilz, Günter (1998). *Applied Abstract Algebra* (2nd ed.). Springer. IndianReprint 2014.
3. Davey, B. A., & Priestley, H. A. (2002). *Introduction to Lattices and Order* (2nd ed.). Cambridge University press, Cambridge.
4. Lidl, Rudolf & Pilz, Gunter. (2004). *Applied Abstract Algebra* (2nd ed.), Undergraduate Texts in Mathematics. Springer (SIE). Indian Reprint.

# Teaching plan (DSE-1 (ii): Discrete Mathematics):

**Week 1:** Definition, Examples and properties of posets, Maps between posets.

* 1. Chapter 7 (Sections 7.5, and 7.6, Pages 493 to 511)

**Weeks 2 and 3:** Algebraic lattice, Lattice as a poset, Duality principle, Sublattice, Hasse diagrams; Products and homomorphisms of lattices, Distributive lattice, Complemented lattice.

[1] Chapter 7 (Section 7.6, Pages 511 to 521)

**Week 4:** Boolean algebra, Boolean polynomial, CN form, DN form.

[1] Chapter 10 (Sections 10.1, and 10.2, Pages 687 to 698)

**Week 5:** Simplification of Boolean polynomials, Karnaugh diagram.

[1] Chapter 10 (Section 10.4, Pages 704 to 718)

**Week 6:** Switching circuits and its applications, Finding CN form and DN form.

[1] Chapter 10 (Section 10.3, Pages 698 to 704)

**Week 7:** Graphs, Subgraph, Complete graph, Bipartite graph,

[1] Chapter 8 (Sections 8.1, and 8.2, Pages 527 to 549)

**Week 8:** Degree sequence, Euler’s theorem for sum of degrees of all vertices.

[1] Chapter 8 (Sections 8.3, and 8.4, Pages 549 to 571)

**Week 9:** Eulerian circuit, Seven bridge problem, Hamiltonian cycle.

[1] Chapter 8 (Section 8.5, Pages 571 to 584)

**Week 10:** Adjacency matrix, Dijkstra’s shortest path algorithm (improved version), Digraphs.

[1] Chapter 8 (Section 8.6, Pages 585 to 595)

**Week 11 and 12:** Definitions and examples of tree and spanning tree.

[1] Chapter 9 [Sections 9.1 (Pages 623 to 634), 9.3, and 9.4 (Pages 649 to 673)]

**Week 13:** Kruskal’s algorithm to find the minimum spanning tree.

[1] Chapter 9 (Section 9.5, Pages 675 to 680)

**Week 14:** Planar graphs, coloring of a graph and chromatic number.

1. Chapter 8 (Section 8.7, and 8.8, Pages 595 to 613).

# Facilitating the Achievement of Course Learning Outcomes

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| **Unit No.** | **Course Learning Outcomes** | **Teaching and Learning Activity** | **Assessment Tasks** |
| 1. | Learn about partial ordering  of sets and various types of lattices. | 1. Each topic to be explained withexamples. 2. Students to be involved in discussions and encouraged to ask questions. | * Student presentations. * Participation in discussions. * Assignments and class tests. |
| 2. | Learn about Boolean algebra  and switching circuits with Karnaugh maps. |

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| 3. | Know about basics of graph theory and four color map problem. | 1. Students to be given homework/assignments. 2. Students to be   encouraged togive short presentations. | * Mid-term examinations. * End-term examinations. |

**Keywords:** CN and DN form, Digraphs and planar graphs, Distributive and complemented lattice, Eulerian circuit, Karnaugh diagram, Posets and its lattices, Seven bridge problem, Switching circuits and its applications.

# Tentative date of assessments/ assignments (time frame):

**Test -1 in the mid of August.**

# Test-2 and Assignment-1 in mid of September. Test -3 and Assignment-2 in mid of October.

**Criteria of Assessment: Written Tests/Assignments/Presentations/Mock Tests/Viva Voice Examinations/Performance in Inter-College academic activities.**