Shyama Prasad Mukherji College

Teaching Plan

**Course and Year :** B.Sc(H) Maths 3rd yr. 2022-23

# Semester V

**Paper** : Discrete Mathematics

# Taught individually or shared : Shared

**Faculty :** Mrs. Neeru Jain and Man Singh

**No. of Classes :** 5 (per week)

# Course Objectives:

The course aims at introducing the concepts of ordered sets, lattices, sublattices and homomorphisms between lattices. It also includes introduction to modular and distributive lattices along with complemented lattices and Boolean algebra. Then some important applications of Boolean algebra are discussed in switching circuits. The second part of this course deals with introduction to graph theory, paths and circuits, Eulerian circuits, Hamiltonian graphs and finally some applications of graphs to shortest path algorithms.

# Course Learning outcomes:

After the course, the student will be able to:

1. Understand the notion of ordered sets and maps between ordered sets.
2. Learn about lattices, modular and distributive lattices, sublattices and homomorphisms between lattices.
3. Become familiar with Boolean algebra, Boolean homomorphism, Karnaugh diagrams, switching circuits and their applications.
4. Learn about basics of graph theory, including Eulerian graphs, Hamiltonian graphs.
5. Learn about the applications of graph theory in the study of shortest path algorithms.

# Unit 1: Ordered Sets

Definitions, Examples and basic properties of ordered sets, Order isomorphism, Hasse diagrams, Dual of an ordered set, Duality principle, Maximal and minimal elements, Building new ordered sets, Maps between ordered sets.

# Unit 2: Lattices

Lattices as ordered sets, Lattices as algebraic structures, Sublattices, Products and homomorphisms; Definitions, Examples and properties of modular and distributive

lattices, The M3 – N5 theorem with applications, Complemented lattice, Relatively complemented lattice, Sectionally complemented lattice.

**Unit 3:** Boolean Algebras and Switching Circuits Boolean algebras, De Morgan’s laws, Boolean homomorphism, Representation theorem; Boolean polynomials, Boolean polynomial functions, Disjunctive normal form and conjunctive normal form, Minimal forms of Boolean polynomial, Quine−McCluskey method, Karnaugh diagrams, Switching circuits and applications of switching circuits.

**Unit 4:** Graph Theory Introduction to graphs, Königsberg bridge problem, Instant insanity game; Definition, examples and basic properties of graphs, Subgraphs, Pseudographs, Complete graphs, Bipartite graphs, Isomorphism of graphs, Paths and circuits, Eulerian circuits, Hamiltonian cycles, Adjacency matrix, Weighted graph, Travelling salesman

problem, Shortest path, Dijkstra’s algorithm.

# Teaching Plan (DSE-2 (ii): Discrete Mathematics):

**Weeks 1 and 2:**

Definitions, Examples and basic properties of ordered sets, Order isomorphism, Hasse diagrams, dual of an ordered set, Duality principle, Maximal and minimal elements sets, Maps between ordered sets.

[1] Chapter 1 (Sections 1.1 to 1.5 and 1.14 to 1.18), Chapter 5 ( Sections 5.1 – 5.11).

[3] Chapter 1 [Section 1 (1.1 to 1.3)]

# Weeks 3 and 4:

Lattices as ordered sets, Lattices as algebraic structures, Sublattices, Products and homomorphisms.

[1] Chapter 2 (Sections 2.1 to 2.19) [3] Chapter 1 [Section 1 (1.5 to 1.20)]

# Week 5:

Definitions, Examples and properties of Modular and Distributive lattices.

[3] Chapter 1 [Section 2 (2.1 to 2.6).

# Week 6:

M3 – N5 Theorem with applications, Complemented lattice, Relatively complemented lattice, sectionally complemented lattice.

[1] Chapter 4 (Sections 4.10, and 4.11) [3] Chapter 1 [Section 2 (2.7 to 2.14)]

# Weeks 7 and 8:

Boolean Algebras, De Morgan’s laws, Boolean polynomials, Boolean polynomial

functions, Disjunctive normal form and conjunctive normal form.

[3] Chapter 1 (Sections 3, and 4)

***Week 9:***

Minimal forms of Boolean polynomial, Quinn-McCluskey method, Karnaugh diagrams.

[3] Chapter 1 (Section 6)

# Week 10:

Switching circuits and applications of switching circuits.

[3] Chapter 2 (Sections 7, and 8).

# Weeks 11 and 12:

Introduction to graphs, Konigsberg Bridge problem, Definition, Examples and basic properties of graphs, Subgraphs, Pseudographs, Complete graphs, Bipartite graphs, Isomorphism of graphs.

[2] Chapter 9 [Sections 9.1, 9.2 (9.2.1, 9.2.7), and 9.3]

# Weeks 13 and 14:

Paths and circuits, Eulerian circuits, Hamiltonian cycles, Adjacency matrix, Weighted graph, Travelling salesman problem, shortest path, Dijkstra’s algorithm.

[2] Chapter 10 [Sections 10.1 to 10.4 (10.4.1 to 10.4.3)]

**Readings (in APA format)**

**Readings prescribed in the syllabus for each unit**

**Unit – I** [1]: Chapter 1 (till the end of 1.18), Chapter 2 (Sections 2.1‐2.13), Chapter 5 (Sections 5.1‐5.11).

[3]: Chapter 1 (Section 1).

**Unit – II:** [1]: Chapter 6.

[3]: Chapter 1 (Sections 3‐4, 6), Chapter 2 (Sections 7‐8).

**Unit – III:** [2]: Chapter 9, Chapter 10.

**Reference Book**

1. **B A. Davey** and **H. A. Priestley**, *Introduction to Lattices and Order,* Cambridge University Press, Cambridge, 1990.
2. **Edgar G. Goodaire** and **Michael M. Parmenter**, *Discrete Mathematics with Graph Theory* (2nd Edition), Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2003.
3. **Rudolf Lidl** and **Günter Pilz**, *Applied Abstract Algebra* (2nd Edition), Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

**Suggested Book :**

1. **Oscar Levin ,** An Open Introduction of Discrete Mathematics( 3rd Edition ), School of Mathematical Science University of Northern Colorado Greeley, Co 80639.
2. **V.K .Balakrishan**, Introductory-Discrete-Mathematics-Computer- Science/dp/0486691152, Dover Publications Inc.;

New edition (1 February 2000) .

1. **Seymour Lipschutz and Marc Lars Lipson,** Schaums-Outline-Discrete- Mathematics-Revised/dp/0071615865, McGraw- Hill Education; 3rd edition (16 October 2009).
2. **M. K. Gupta ,** Discrete Mathematics , First edition 2003 , Krishna Prakashan Media(P) LTD**.**
3. **T Veerarajan ,** Discrete Mathematics with Graph theory and Combinatorics , The McGraw –Hill Companies.

**No of classes required to complete the unit (approx.):**

* + **Unit I:** 15-17 Classes
  + **Unit II:** 14 -16 Classes
  + **Unit III:** 25-27 Classes

**Sub topics to be covered and their order along with the respective time frames (if any) Methodology of Teaching:**

**(Mention the use of ICT, MOOCs fieldwork, visits, or any specific activities apart from lectures)**

**ASSESSMENT**

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

Test- 1 in the end of Fourth Weeks.

Test - 2 and Assignment-1 in end of Eight’s Week Test- 3 and Assignment –2 in end of Eleventh’s Week.

**Criteria of Assessment:** Written tests/ Assignments/Mock test/ Viva Voice Examination.

2