

# MATHEMATICAL STRUCTURES

UG – IV Semester – CS, IS, AI & ML and CSD

Course coordinator: Dr Geetha N K

Course code : 21MAT41A

Credits : 03

L: P: T: S : 3:0:0: 0

CIE Marks : 50

Exam Hours: 03

SEE Marks: 50

Total Hours : 40

## Course objectives:

1. To introduce the basics of Set Theory, Number Theory and some of its applications.
2. To understand and apply the problem-solving skills by using truth tables, basic logical connectives and proofs.
3. To understand the Properties of Relations and various types of functions also graph theory concepts to apply some of its applications in computer science.

**Course Outcomes: At the end of the course, student will be able to:**

|     |   |
|-----|---|
| CO1 | Understand basic concepts of Set Theory & Number Theory, Fundamental logics, functions, Relations and Graph Theory.   |
| CO2 | Analyze the logic for validity of the given arguments, sets and perform operations and algebra on sets, properties of Functions, Relations and Graph Theory.  |
| CO3 | Apply the concepts of Relations, Hasse Diagram and Poset, Mathematical Logics, Functions and Number Theory, Graph theory in Engineering Problems.   |
| CO4 | Evaluate functions like Stirling numbers using fundamental principles, logical propositions via truth tables, combinations and permutations on sets, relations and digraphs, trees in Engineering field.  |
| CO5 | Solve the engineering problems using mathematical logic, recurrence relations, even and odd integers, rational and irrational numbers and divisibility using Number Theory, connection between bijective functions and real life problems using graphs and trees. |

## Mapping of Course outcomes to Program outcomes:

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 3   | 1   | 1   |     |     |     |     |     |      |      |      |
| CO2 | 3   | 3   | 2   | 1   |     |     |     |     |     |      |      |      |
| CO3 | 3   | 3   | 2   | 1   |     |     |     |     |     |      |      |      |
| CO4 | 3   | 3   | 1   | 1   |     |     |     |     |     |      |      |      |
| CO5 | 3   | 3   | 2   | 1   |     |     |     |     |     |      |      |      |

| Module | Contents of the Unit   | Hours | COs              |
|--------|--|-------|------------------|
| 1      | <b>Set Theory and Number Theory:</b><br>Sets and Subsets, Set Operations and the Laws of Set Theory, Addition Principles, Concept of Number Theory-Simple Problems- Case study.<br>Pedagogy : Chalkand talk/PowerPoint Presentation/Videos<br>Web Link : <a href="https://onlinecourses.nptel.ac.in/noc20_ma42/preview">https://onlinecourses.nptel.ac.in/noc20_ma42/preview</a><br>Video Lectures :                                   | 08    | CO1-CO5<br>L1-L4 |
| 2      | <b>Fundamentals of Logic:</b><br>Basic Connectives and Truth Tables, Logical Equivalence – The Laws of Logic, Logical Implication– Rules of Inference, Quantifiers with one variable- Case study.<br>Pedagogy : Chalkand talk/PowerPoint Presentation/Videos<br>Web Link : <a href="https://nptel.ac.in/courses/106102013">https://nptel.ac.in/courses/106102013</a><br>Video Lectures :   | 08    | CO1-CO5<br>L1-L4 |
| 3      | <b>Functions:</b><br>Cartesian Products, Functions – Plain and One-to- One, Onto Functions – Stirling Numbers of the Second Kind, The Pigeon-hole Principle, Function Composition- Case study.<br>Pedagogy : Chalkand talk/PowerPoint Presentation/Videos<br>Web Link : <a href="https://nptel.ac.in/courses/111107058">https://nptel.ac.in/courses/111107058</a><br>Video Lectures :  | 08    | CO1-CO5<br>L1-L4 |
| 4      | <b>Relations:</b> Properties of Relations, Computer Recognition: Zero-One Matrices and Directed Graphs, Partial Orders – Hasse Diagrams, Equivalence Relations and Composition of Relations- Case study.<br>Pedagogy : Chalkand talk/PowerPoint Presentation/Videos<br>Web Link: <a href="https://archive.nptel.ac.in/courses/111/107/111107058/">https://archive.nptel.ac.in/courses/111/107/111107058/</a><br>Video Lectures :       | 08    | CO1-CO5<br>L1-L4 |
| 5      | <b>Graph Theory &amp; Its Applications:</b> Definitions and Examples, Sub graphs, Complements, and Graph Isomorphism, Euler Trails and Circuits, Hamiltonian paths, cycles, Basics of Graph Coloring- Case study.<br>Pedagogy : Chalkand talk/PowerPoint Presentation/Videos<br>Web Link : <a href="https://onlinecourses.nptel.ac.in/noc20_ma05/preview">https://onlinecourses.nptel.ac.in/noc20_ma05/preview</a><br>Video Lectures : | 08    | CO1-CO5<br>L1-L4 |
|        | <b>Self Study:</b><br><b>Module 1:</b> Cardinality Properties of Set Theory and Applications of Number Theory<br><b>Module 2:</b> Validity of arguments in propositional calculus and Uses of Logics<br><b>Module 3:</b> Classification of function and Inverse Function.<br><b>Module 4:</b> Relational matrix and graph of a relation<br><b>Module 5:</b> Graph Homomorphism and its applications.                                   |       |                  |

**Text Books:**

1. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education. 2006, ISBN-10. 9788177584240.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43<sup>rd</sup> Edition, 2014 June, ISBN: 9788174091956.
3. David Burton, Elementary Number Theory | 7th Edition, Mc Graw Hill Higher Education 2006  
ISBN 978-0-07-338314-9.

**Reference Books:**

1. Basavaraj S Anami and Venakanna S Madalli: Discrete Mathematics – A Concept based approach, Universities Press, 2016, ISBN: 9788173719998.
2. Kenneth H. Rosen: Discrete Mathematics and its Applications, 7th Edition, McGraw Hill, 2007, ISBN 978-0-07-338309-5.
3. Thomas Koshy: Discrete Mathematics with Applications, Elsevier, 2003, Reprint 2008, ISBN: 0124211828.
4. Susanna S. Epp: Discrete Mathematics with Applications, Printed in the United States of America, 2018, 5th Edition, ISBN: 978-0-357-03523-8