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| **COURSE TITLE** | **DISCRETE MATHEMATICAL STRUCTURES** |
| **COURSE CODE** | **01AI0402** |
| **COURSE CREDITS** | **4** |

**Objective:**

1 This course provides some of the mathematical foundations and skills the learners need in their further study of Artificial intelligence and Machine learning. This course will discuss fundamental concepts and tools in discrete mathematics with emphasis on their applications to computer science. Topics include logic and predicates, relations, Lattice, Boolean algebra, recurrence relations, Algebraic structures, trees and graphs.

2 This course provides some of the mathematical foundations and skills the learners need in their further study of Artificial intelligence and Machine learning. This course will discuss fundamental concepts and tools in discrete mathematics with emphasis on their applications to computer science. Topics include logic and predicates, relations, Lattice, Boolean algebra, recurrence relations, Algebraic structures, trees and graphs. This course serves as an introductory course in discrete mathematics for second year B. Tech. Computer Engineering - AI students.

**Course Outcomes:** After completion of this course, student will be able to:

1 Apply concept of Predicate Calculus in computer science like design of computing machines, artificial intelligence and for programming languages etc. (Application)

2 Understand the concepts of Relation, Lattices, and Boolean Algebraic analysis (Knowledge, Comprehension)

3 Formulate and solve certain first order and second order recurrence relations. (Understand)

4 Use the properties of algebraic structures. (Knowledge, Comprehension)

5 Apply abstract concepts of graph theory in modeling and solving non-trivial problems in different field of study. (Application, Analysis)

**Pre-requisite of course:**NA

**Teaching and Examination Scheme**

| Theory Hours | Tutorial Hours | Practical Hours | ESE | IA | CSE | Viva | Term Work |
|---|---|---|---|---|---|---|---|
| 3 | 0 | 2 | 50 | 30 | 20 | 25 | 25 |

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 1 | **Propositional and Predicate Logic**<br>Definition, Statements & Notation, Truth Values, Statement Formulas & Truth Tables, Tautologies, Equivalence of Formulas, Tautological Implications, Examples, predicates, Rules of quantifiers. Rules of Inference for propositions and predicates | 6 |

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| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 2 | **Relation, Lattices and Boolean algebra**<br>Relation, different types of relation, Properties of relation, Relation Matrix and Graph of a Relation, Equivalence Relation, Transitive Closure, Poset, Hasse diagram, Lattice as Poset Properties of lattices, Lattice as an algebraic system, Bounded, distributive and complemented lattices, Boolean algebra (Definitions and simple examples only) | 12 |
| 3 | **Recurrence Relation**<br>Definition, Order of recurrence relation, homogeneous and non-homogeneous recurrence relation, method of undetermined coefficient. | 4 |
| 4 | **Algebraic Structures**<br>Algebraic structures with one binary operation, Semigroup, Monoid, Group, Subgroup, normal subgroup, group Permutations, Coset, homomorphic subgroups, Lagrange's theorem, Congruence relation and quotient structures, Algebraic structures (Definitions and simple examples only) with two binary operation- Ring, Integral domain and field. | 9 |
| 5 | **Concepts of Graphs and Trees**<br>Definition of a graph theory, incidence and degree, walks, paths, circuits, Connectedness, Eulerian and Hamiltonian graphs, Trees, basic properties of trees, Binary trees , Spanning and Minimal spanning trees, Connectivity and Separability, fundamental circuits and cut sets Isomorphism of graphs, Matrix representation of graphs, adjacency and incidence matrix, Graph theoretical algorithms: Dijkstra, prims and Kruskal | 11 |
| **Total Hours** | | **42** |

**Suggested List of Experiments:**

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 1 | **Propositional and Predicate Logic**<br>Propositional and Predicate Logic | 4 |
| 2 | **Relation, Lattices and Boolean algebra**<br>Relation, Lattices and Boolean algebra | 8 |
| 3 | **Recurrence Relation**<br>Recurrence Relation | 4 |
| 4 | **Algebraic Structures**<br>Algebraic Structures | 4 |
| 5 | **Concepts of Graphs and Tree**<br>Concepts of Graphs and Tree | 8 |
| **Total Hours** | | **28** |

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**Textbook :**

1 Discrete mathematics and its applications, 7th edition, Rosen Kenneth, McGraw hill- New Delhi, 2020

2 Graph Theory with Applications to Engineering and Computer Science, Narsingh deo, PHI, 1974

**References:**

1 Discrete Mathematics for Computer Science, Discrete Mathematics for Computer Science, Stanat and McAlister, PHI, 1977

2 Discrete mathematical structures for computer science , Discrete mathematical structures for computer science , B. Kolman and R.C. Busby, PHI, -

**Suggested Theory Distribution:**

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

| Distribution of Theory for course delivery | | | | | |
|---|---|---|---|---|---|
| **Remember / Knowledge** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Higher order Thinking / Creative** |
| 30.00 | 40.00 | 30.00 | 0.00 | 0.00 | 0.00 |

**Instructional Method:**

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

4 Students will use supplementary resources such as online videos, NPTEL Videos, e-courses, Virtual Laboratory.

**Supplementary Resources:**

1 https://www.tutorialspoint.com/discrete_mathematics/index.htm

2 https://www.coursera.org/learn/discrete-mathematics

3 https://onlinecourses.nptel.ac.in/noc22_cs04/preview

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