

DISCRETE STRUCTURE

ENCT 251

Lecture : 3
Tutorial : 1
Practical : 0

Year : II
Part : II

Course Objectives:

The objective of this course is to provide basic understanding in discrete mathematics and finite state machine. It also emphasizes to build fundamental and conceptual clarity in the area of logic, reasoning, proof, recurrence relation, graph theory, theory of automata and algorithmic analysis.

- 1 Logic and Induction (8 hours)**
 - 1.1 Review of set theory, relation and function
 - 1.2 Proposition, connectives in proposition, types of propositions, truth function and propositional logic
 - 1.3 Expressing statements in logic propositional logic, rules of inference in propositional logic, validity of an argument, methods of tableaux
 - 1.4 Predicate logic and quantification, informal deduction in predicate logic

- 2 Proof Techniques (5 hours)**
 - 2.1 Formal proofs and informal proofs, mathematical reasoning- direct proof and indirect proof (Proof by contradiction and proof by contraposition)
 - 2.2 Elementary induction and complete induction, strong induction
 - 2.3 Proof by counter example, vacuous and trivial proofs, proof by cases, mistakes in proof

- 3 Automata Theory, Regular Language and Grammar (10 hours)**
 - 3.1 Alphabet, string, string operations and language, introduction to finite automata
 - 3.2 Deterministic finite automata (DFA), representation and language of DFA
 - 3.3 Non deterministic finite automata (NFA), equivalence of DFA and NFA
 - 3.4 Regular expressions and its characteristics, regular language and its properties
 - 3.5 Equivalence of regular expression and finite automata
 - 3.6 Context free grammar and context free language

4 Recurrence Relation and Algorithmic Analysis (7 hours)

- 4.1 Recurrence relations, recurrence relation for tower of Hanoi (TOH) and Fibonacci series, solving linear recurrence relations (Homogeneous and non-homogeneous)
- 4.2 Algorithm and its properties, asymptotic notation of algorithm
- 4.3 Linear and binary search and their analysis; Bubble and insertion sorting and their analysis

5 Graph Theory and Tree (15 hours)

- 5.1 Graphs basics, graph terminologies, graph types (Directed, un-directed, simple, weighted, regular, complete, bipartite, planar graph) and special graphs
- 5.2 Subgraphs, graph representation, connectivity in graphs and its components, strongly and weakly connected graphs
- 5.3 Paths and circuits, Euler path and circuit, Hamiltonian path and circuit
- 5.4 Shortest path algorithm (Dijkstra's algorithm), graph coloring and four color theorem, applications of graph coloring.
- 5.5 Graph as network, maximal flows and minimal cuts, the max flow-min cut theorem
- 5.6 Introduction and applications, tree traversals, spanning trees, minimum spanning trees (Prim's and Kruskal's algorithm)

Tutorial (15 hours)

1. Problem related to function, relation and validity of an arguments using rules of inference in propositional and predicate logic
2. Problem related to proof techniques
3. Design of automata, conversion from NFA to DFA, defining grammar for language and properties of regular language
4. Problem related to different recurrence relation including TOH, Fibonacci series and homogeneous and non-homogeneous recurrence relation
5. Representation of graph, finding shortest path, obtaining minimum spanning tree, problems related to planar graph, graph coloring and maximum flow
6. Defining the complexity of liner and binary search, problems related to bubble and insertion sorting algorithms

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	8	10
2	5	7
3	10	14
4	7	9
5	15	20
Total	45	60

* There may be minor deviation in marks distribution.

References

1. Rosen, K. H. (2019). Discrete Mathematics and Its Applications. United Kingdom: McGraw-Hill.
2. Johnsonbaugh, R. (2007). "Discrete Mathematics", Prentice Hall Inc.
3. Chartrand, G., Oellermann, O. R. (1993). Applied and Algorithmic Graph Theory. Singapore: McGraw-Hill.
4. Lewis, H. R., Papadimitriou, C. H. (1981). Elements of the Theory of Computation. United Kingdom: Prentice-Hall.
5. Cormen, T. H., Leiserson, C. E., Stein, C., Rivest, R. L. (2009). Introduction to Algorithms, Third Edition. France: MIT Press.