Discrete Structure

EG2104CT

Year: II **Total: 4 hours /week**

Part: I **Lecture: 3 hours/week**

Tutorial: 1 hour/week

Practical: … hours/week

Lab: … hours/week

Course description:

This course is designed to cover fundamental concepts of discrete structure like logic, proofs, sets, relations, functions, counting, and probability, with an emphasis on applications in computer science with an emphasis on applications in computer science.

Course objectives:

After completion of this course students will be able to:

1. Demonstrate critical thinking, analytical reasoning, and problem-solving skills
2. Implement the concepts of Counting, Probability, Relations and Graphs respectively.
3. Construct graphs and charts, interpret them, and draw appropriate conclusions

Course Contents:

Theory

Unit 1. Introduction to Set, Relations and Functions [8 Hrs.]

1.1. Introduction to Set Theory:
  1.1.1. Concept of Sets, Subsets and Power Set
  1.1.2. Set Operations: Union, Intersection, Difference, Cartesian Product, Venn Diagram, Computer Representation of Sets
  1.1.3. Fuzzy Sets and membership functions

1.2. Functions: Basic Concept, Injective and Bijective Functions, Inverse and Composite

1.3. Functions, Graph of Functions, Functions for Computer Science (Ceiling Function, Floor Function, Boolean Function, Exponential Function)

1.4. Relations: Relations and their Properties, N-ary Relations with Applications, Representing Relations, Reflexive, symmetric and transitive relations, Equivalence Relations, Partial Ordering

Unit 2. Logical Reasoning and Proof Techniques [10 Hrs.]

2.1. Logic: Propositional logic, logical connectives, laws of equivalences, Predicate and Quantifiers, Rules of Inference in Propositional and Predicate logic

2.2. Proof Methods: Basic Terminology, Direct and Indirect proof (contraposition, contradiction), Proof by mathematical induction

Unit 3. Automata Theory [8 Hrs.]

3.1. Finite State Automata:
  3.1.1. DFA (Deterministic Finite Automata): Formal Definition, Representation, Design
  3.1.2. NFA (Non-Deterministic Finite Automata): Formal Definition, Representation, Design, NFA to DFA conversion
  3.1.3. Regular Expression: Formal Definition, Design

3.2. Grammar Concept:
  3.2.1. Chomsky hierarchy

3.2.2. Context free grammar: Derivation, Parse TREE, Language computation and Grammar design
3.2.3. Regular grammar to finite Automata and vice versa

Unit 4. Recurrence Relation [7 Hrs.]

4.1. Counting Theory: Sum and Product Rule, Pigeonhole Principle, Permutation and Combination, Binomial Expansion
4.2. Recurrence Relation: Linear Recurrence Relations, Solving linear homogeneous recurrence relation with constant coefficients (upto order two)

Unit 5. Graph Theory [12 Hrs.]

5.1. Graphs: Graph definition and types, Representation (Adjacency list, Adjacency and Incidence Matrix), Degree of Vertex, Handshaking Theorem, Cycle, wheel, Regular graph, Bi-Partite Graph
5.2. Connectivity in Graphs: Paths and circuits, complete graph, Weakly and Strongly connected graph, Euler and Hamilton Graph
5.3. Planar graph and Planar representation of graph, Graph Coloring
5.4. Graph Traversal (BFS and DFS)
5.5. Trees: Introduction and Applications, M-ary tree, Binary Tree and properties, Depth of Tree, Applications, Tree Traversals (Pre-order, Post-order and In-order Traversal)

Final written exam evaluation scheme			
Unit	**Title**	**Hours**	**Marks Distribution***
1	Introduction to Set, Relation and Function	8	14
2	Logical Reasoning and Proof Techniques	10	18
3	Automata Theory	8	14
4	Recurrence Relations	7	12
5	Graph Theory	12	22
	Total	**45**	**80**

* There may be minor deviation in marks distribution.

References:

1. Kenneth H. Rosen. Discrete Mathematics and Its Applications, 7th Edition, McGraw Hill, 2012.
2. R. Johnsonbaugh, “Discrete Mathematics”, Prentice Hall Inc.
3. Joe L. Mott, Abrahan Kandel, and Theodore P. Baker, “Discrete Mathematics for Computer Scientists and Mathematicians”, Prentice-Hall of India