Discrete Structures
CS104 : 3 *(3 lectures, 0 lab, 0 exercises)*

Prerequisites:
NO

Objectives:

1. Summary of the main learning outcomes for students enrolled in the course.
Upon successful completion of the course, the student should be able to:
(a) Develop an understanding of the basic mathematical structures and objects useful in the study of computer science.
(b) Identify some of the applications of these mathematical structures in other fields of computer science such as data structures and algorithms, databases, networks, operating systems etc.
(c) Comprehend as well as write algorithms for simple mathematical problems.
(d) Demonstrate knowledge of the topics and its applications in other computer science fields.
2. Briefly describe any plans for developing and improving the course that are being implemented. (eg increased use of IT or web based reference material, changes in content as a result of new research in the field)

Course Description:
- General description in to be used for the Bulletin or Handbook

This course will introduce the student to a body of mathematical concepts essential for the mastery of some of the higher-level computer science courses. Topics include: Set theory, Functions and relations, Propositional and predicate logic, Proof techniques, Recursive Algorithms, Elementary combinatorics and Counting methods, Graph theory, and Discrete probability.

Syllabus:
1- **Logic Theory:** Propositional Logic – Negation, Conjunction, Disjunction, Implication, Biconditional, Converse, Contraposition, Inverse, Logic and Bit Operations, Propositional Equivalence, Predicates and Quantifiers, Nested Quantifiers.
2- **Fundamental Structures:** Set Theory - Set, Subset, Cartesian Product, Power sets, Venn Diagram, Union, Intersection, Complement, Difference, Cardinality. Functions – Injection, Surjection, Bijection; Relations – Relations on a set, Reflexivity, Symmetric, Transitivity, Equivalence.
3- **Proof Techniques:** Rules of Inference, Structure of formal proofs, Direct proofs, Proof by counterexample, Proof by contraposition, Proof by contradiction. Proof by cases, Mathematical induction, Recursive definitions; Algorithms, Recursive Algorithms.
4- **Counting:** Basic counting principle, Counting problems, Inclusion-exclusion principle, Pigeonhole principle, Permutations, Combinations, Binomial coefficients, Recurrence relations.
5- **Graph Theory:** Introduction to Graphs, Graph Models, Graph Terminology, Special Types of Graphs, Representing Graphs, Graph Isomorphism. Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs.
6- **Discrete probability:** Finite probability, Probability of combinations of events, Conditional probability, Independence, Random variables. Bayes' rule, Mathematical expectation.

References:

1- Required Textbox :
Discrete Mathematics and Its Applications, 7th edition by Kenneth H. Rosen, McGraw Hill,2007.
2- Essential References
Discrete Mathematical Structures, 4th edition by Kolman, Busby, and Ross, 2000.
Discrete Mathematics with Graph Theory, 2nd edition by Goodiare and Parmenter, 2002.
Outline of Discrete Mathematics, By Seymor Lipschutz.