Department Of Computer Science and Engineering
Kathmandu University
Dhulikhel, Kavre

Subject: Combinatorics **Course: MATH – 322**

Level: B.Sc/3rd Year/2nd Semester **Credit Hours: 3**

Objectives: To impart a basic understanding on the topics of combinatorics, recurrence relation, group structures with fundamental properties and applications.

Course Contents

1. **Unit 1: Set Theory and Logic [5 hours]**
    - Set operations, Laws of Set theory, Principle of duality.
    - Indexed set, Generalized De Morgan's Laws.
    - Laws of logic and Methods of Proof with Examples.

2. **Unit 2: Properties of Integers: Mathematical Induction [10 hours]**
    - The Well-ordering Principle: Mathematical Induction.
    - Proof of Mathematical Induction: Strong form with Examples.
    - Recursive de nition, Division Algorithm theorem with Proof.
    - The Greatest Common Divisor (GCD): The Euclidean Algorithm with properties.
    - The fundamental theorem of Arithmetic: Diophantine equation & Integer solutions.

3. **Unit 3: Elementary Combinatorics [10 hours]**
    - Basic of Counting: Permutations & Combinations.
    - Enumeration of Combinations & Permutations.
    - Enumerating Combinations & Permutations with repetitions.
    - The Binomial and Multinomial Theorems and associated properties.
    - Functions for Computers, The Principle of inclusion and exclusion.

4. **Unit 4: Recurrence relations [10 hours]**
    - Generating functions of Sequences.
    - Partitions of integers, Exponential generating functions.
    - Calculating coefficients of generating functions.
    - Recurrence relations and solving these by the methods of substitution and generating functions.
    - The method of characteristic roots: Second order linear homogeneous with constant coefficients.

- Solution of non-homogeneous recurrence relations.

5. **Unit 5: Groups [10 hours]**
    - De nitions of group and subgroups with associated properties.
    - Homomorphism and Isomorphism on groups.
    - Cyclic groups with properties.
    - Permutation groups with Examples.
    - Cosets and Lagrange’s Theorem.
    - Counting and equivalence: Burnside’s Theorem.

Text Books

1. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics, 4th Edition, Pearson Edu-cation, 2002.
2. Joe L. Mott, Abraham Kandel and Theodore P. Baker, Discrete Mathematics for Com-puter Scientists and Mathematicians, PHI, New Delhi, 2008.

Reference Books

1. Larry J. Gerstein, Introduction to Mathematical Structures and Proofs, 2nd Edition, Springer, 2012.
2. K. D. Joshi, Foundations of Discrete Mathematics, New Age International, PVT, New Delhi.
3. Thomas Koshy, Discrete Mathematics with Applications, Elsevier, 2009.
4. Kenneth H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7th Edition, McGraw Hill, 2011.