Kotebe University of Education
College of Natural and Computational Sciences
Department of Mathematics

Course Syllabus on 'Introduction to Combinatorics and Graph Theory'

Course Code: Math 2032

Credit Hours/ ECTS: 3, **Contact hrs:** 3, **Tutorial hrs:** 2

Length of time to complete the course: 16 weeks

Total number of load hours the student will carry to complete the course: 189 hrs

Prerequisite courses: Math 2042, Math 2052

Course category: Compulsory

Year: II Semester: II

Program: B.SC. in Mathematics

Aims

The course sets the necessary background for students to understand the subsequent application area courses such as probability, network, etc

Course description

This course deals with review of sets and functions, fundamental principles of counting, recurrence relations, graph theory and its application.

Learning Outcomes

On completion of the course successful students will be able to:

- know basic concepts of discrete mathematics,
- understand the principles of counting, recurrence relations and generating functions,
- understand the basic concepts of graph and their types,

- know the basic algorithms on graphs,
- use the methods and principles of Combinatorics
- apply Combinatorics in counting problems,
- Solve simple counting problems,
- construct graphs with given degree patterns,
- apply graph theory to solve network oriented problems.

Mode of Delivery: This course will be offered in a semester based mode of delivery

Course Contents

1. **Elementary counting principles (9 hrs)**
   - 1.1 Basic counting principle
   - 1.2 Permutations and combinations
   - 1.3 The inclusion-exclusion principles
   - 1.4 The pigeonhole principle
   - 1.5 The binomial theorem
2. **Recurrence relations (9 hrs)**
   - 2.1 Definition and examples
   - 2.2 Linear recurrence relations with constant coefficient
   - 2.3 Solutions of linear recurrence relations
   - 2.4 Solutions of homogeneous and non - homogeneous recurrence relations
3. **Elements of graph theory (12 hrs)**
   - 3.1 Definition and examples of a graph
   - 3.2 Matrix representation of a graph
   - 3.3 Isomorphic graphs
   - 3.4 Path and connectivity of a graph
   - 3.5 Complete, regular and bipartite graphs
   - 3.6 Eulerian and Hamiltonian graphs
   - 3.7 Trees and forests (Rooted and Binary trees)
   - 3.8 Planar graphs
   - 3.9 Graph coloring

4. **Directed graphs (8 hrs)**

   4.1 Definition and examples of digraphs

   4.2 Matrix representation of digraphs

   4.3 Paths and connectivity

5. **Weighted graphs and their applications (10 hrs)**

   5.1 Weighted Graphs

   5.2 Minimal Spanning trees

   5.3 Shortest path problem

   5.4 Critical Path Problem

Teaching-Learning Strategy/Methods

Lectures, Tutorial, Group Assignments

Assessment Strategy/Methods

- Assignment: 20%
- Tests: 30%
- Semester Examination: 50%

Course Policy

A student has to

- Attend at least 85% of the classes
- Take all continuous assessments
- Take final examination
- Respect all rules and regulations of the university

References

[1] Mattson, H. F. (1993). Discrete mathematics with applications. John Wiley & Sons, Inc.

[2] Roman, S. A. (1986). An introduction to Discrete mathematics. Saunders College Publishing.

[3] Rosen, K. H., and Krithivasan, K. (2012). Discrete mathematics and its applications: with combinatorics and graph theory. Tata McGraw-Hill Education.

[4] Epp, S. S. (2010). Discrete mathematics with applications. Cengage learning.

[5] Harris, B. (1970). Graph Theory and its applications. Academic press.

[6] Iyengar, S.N. (2004). Discrete mathematics. Vikas publishing house PVT LTD.

[7] Lipschutz, S. (2016). Schaum's Outlines of Theory and Problems of Discrete Mathematics.

[8] Liu, C. L. (1986). Elements of discrete mathematics. Tata McGraw-Hill Education.

[9] Ore, O. (1974). Theory of graphs. American mathematical Society.