KINGDOM OF SAUDI ARABIA
AL-IMAM MOHAMMAD BIN SAUD
ISLAMIC UNIVERSITY
FACULTY OF SCIENCES
DEPARTMENT OF MATHEMATICS

المملكة العربية السعودية
جامعة الإمام محمد بن سعودالإسلامية
كلية العلوم
قسم الرياضيات والإحصاء

Cour se Code	Course Num.	Course Name	Credit Hours	Lec	Lab	Tut	Prerequisites
MAT	354	**Combinatorics and Graphs**	4	3	0	2	MAT223

Objectives:

This course is divided in two parts: Combinatorics and Graphs.

The objectives of the first part are to learn basics of counting, recursion and recurrence Relations.

The objective of the second part is to introduce students to graph theory, especially Euler and Hamiltonian graphs, planar graphs, coloring graphs, shortest paths, isomorphisms of graphs, spanning trees and network flow.

Syllabus:

Combinatorics:

- Principals of counting: Addition and multiplication principles; inclusion-exclusion principle; Application of inclusion-exclusion; pigeon whole principle and applications, generating functions, multiplication of generating functions.
- Recursion: Recurrence definitions. Recurrence relations; generalized binomial theorem.
- Linear recurrence equations: Homogeneous and non homogeneous linear recurrences with constant coefficients; binary trees; random walks.

Graphs:

- Introduction to Graphs: Concepts and definitions, Isomorphisms of graphs, Subgraphs, Matrices of graphs.
- Eulerian Graphs: characterization of Eulerian graphs, Chinese Postman problem;
- Hamiltonian Graphs: Necessary and sufficient conditions for Hamiltonian graphs, Traveling Salesman problem;
- Planar graphs: Euler's Formula, Kuratowski's theorem.
- Graph colorings: Vertex colorings. Greedy algorithm.
- Shortest path: Shortest path problems, Optimality principle, BFS, DFS, Djkstra's algorithm,
- Trees: Spanning trees, minimum spanning trees, Kruskal's algorithm, Prim's algorithm, Greedy algorithm
- Networks flow: Definitions, flow augmenting paths, cut sets, maximum flow; Ford-Fullkerson algorithm, Minimum cost capacited flow problem.

References:

-Applied Combinatorics by Alan Tucker, Wiley; 5th Edition (2006).
Discrete Mathematics and Its Applications by K. Rosen, Mc Graw-Hill, 6th Edition (2006).
-Graph Theory by V. Balakrishnan, Schaum's Outline, McGraw-Hill; 1st Edition. (1997).
-Graph Theory by A. Bondy and U. S. R. Murty, Springer, 1st Edition (2007). A free
- draft version (Graph Theory with Applications 1982) is available in Internet.