

## MATH 3012 Applied Combinatorics

3-0-0-3 Prerequisite: MATH 1508 or 1712

Elementary combinatorial techniques used in discrete problem solving. Topics include basic counting methods, linear recurrence relations, graph and network models, and related algorithms for searching and sorting.

Text: Ralph P. Grimaldi, Discrete and Combinatorial Mathematics (fifth edition).

### Course Outline

- Topic 1. Fundamental Principles of Counting Sections: 1.1 – 1.4. Addition principle, multiplication principle, permutations, selections, and the binomial theorem. (4 Lectures)
- Topic 2. Induction and Number Theory  
Sections: 4.1–4.5. Induction, the division algorithm, the Euclidean algorithm, the fundamental theorem of Arithmetic. (5 Lectures)
- Topic 3. Relations and Functions  
Sections: 5.1, 5.2, and 5.5. Bijections and the pigeon-hole principle. (2 Lectures)
- Topic 4. Inclusion and Exclusion  
Sections: 8.1–8.5. The principle of inclusion and exclusion, derangements, Rook polynomials, and arrangements with forbidden positions. (5 Lectures)
- Topic 5. Generating Functions  
Sections: 9.1–9.5. Ordinary and exponential generating functions, calculating coefficients, partitions of integers. (5 Lectures)
- Topic 6. Recurrence Relations  
Sections: 10.1–10.4. First order and second linear recurrence relations, homogeneous relations, non-homogeneous relations, and the method of generating functions. (4 Lectures)
- Topic 7. Introduction to Graph Theory  
Sections: 11.1–11.6. Graphs, subgraphs, graph isomorphisms, Euler circuits, Hamilton cycles, planar graphs, graph colorings. (5 Lectures)
- Topic 8. Trees  
Sections: 12.1–12.5. Trees, rooted trees, and weighted trees. (4 lectures)
- Topic 9. Optimization and Matching  
Sections 13.1–13.4. Dijkstra’s algorithm, minimal spanning trees, max-flow-min-cut, and matchings. (5 lectures)

Approximately 39 Lectures