Course Outline for MATH 5053, Discrete Mathematics

MATH 5053 Discrete Mathematics (3 units)
Prerequisite: Graduate standing, MATH 435, or MATH 4052.

Advanced discrete mathematics. Concepts may include the representation theory of the symmetric group, tableaux combinatorics, the RSK algorithm, lattice paths, extremal combinatorics, hypergeometric series algorithms and proof machines, expander families of graphs, Ramsey theory, or finite state machines. 3 lectures. Formerly MATH 530.

	Course Learning Objectives
1	Prove results in discrete mathematics.
2	Apply methods of discrete mathematics to other mathematical disciplines.
3	Read and paraphrase research level articles in discrete mathematics.
4	Apply linear algebra theory to analyze combinatorial objects.
5	Apply combinatorial algorithms to discrete structures.

Expanded Course Content

Textbooks, materials, and/or other resources
The Symmetric Group, by Bruce Sagan

Week	Readings	Topics of Discussion
1	The Symmetric Group: Chapter 1.1-1.3	Matrix representations, G-Modules and the group algebra
2	The Symmetric Group: Chapter 1.4,1.5	Reducibility, complete reducibility and Maschke's theorem
3	The Symmetric Group: Chapter 1.6	G-Homomorphisms and Schur's Lemma
4	The Symmetric Group: Chapter 1.7, 1.8	Commutant and endomorphism algebras, group characters
5	The Symmetric Group: Chapter 1.9	Inner products of characters

Week	Readings	Topics of Discussion
6	The Symmetric Group: Chapter 1.10, 1.11	Decomposition of the group algebra, tensor products again
7	The Symmetric Group: Chapter 1.12	Restricted and induced representations
8	The Symmetric Group: Chapter 2.1, 2.2	Young subgroups, tableaux, and tabloids, dominance and lexicographic ordering
9	The Symmetric Group: Chapter 2.3, 2.4	Specht modules, the submodule theorem
10	The Symmetric Group: Chapter 2.5	Standard tableaux and a basis for the Specht modules
11	The Symmetric Group: Chapter 2.7	Young's natural representation
12	The Symmetric Group: Chapter 3.1-3.3	The RSK algorithm, column insertion, increasing and decreasing subsequences
13	The Symmetric Group: Chapter 3.4, 3.10	The Knuth relations, the hook-length formula
14	The Symmetric Group: Chapter 4.5, 4.6	Schur functions, Jacobi-Trudi determinants
15	The Symmetric Group: Chapter 4.7	The characteristic map

Method of Assessment

The possible methods of assessment are written individual examinations, quizzes, in-class worksheets and presentations, projects, and homework. One or more midterms and a cumulative final exam are required.

Instructional Mode

The instructional mode for this class is face-to-face. This designation means that the essential academic standards of the course require in-class student engagement, and thus remote instruction is not appropriate.