

Course Outline for MATH 3051, Combinatorics I

MATH 3051 Combinatorics I (3 units)

Prerequisite: Junior standing or Mathematics major; completion of GE Area 1 with grades of C- or better; and completion of GE Area 2 with a grade of C- or better; and one of the following: MATH 206, MATH 248, [MATH 1151](#), or [MATH 2031](#).

Methods of enumerative combinatorics: sum, product, and division rules, mathematical induction, bijective and recursive techniques, inclusion and exclusion, and generating functions. The theory of partitions, the calculus of finite differences, elementary graph theory, designs, and codes. 3 lectures. Fulfills GE Area Upper-Division 2 or Upper-Division 5. Formerly MATH 334.

Course Learning Objectives	
1	Apply standard counting techniques to enumeration and probability problems.
2	Define and analyze fundamental discrete mathematical objects.
3	Construct combinatorial proofs of identities using double counting, bijections, and/or involutions.
4	Apply generating functions to investigate properties of integer sequences.
5	Prove and define mathematical statements involving recursion, especially in the context of combinatorics.

Expanded Course Content

Textbooks, materials, and/or other resources
Count On It: An Introduction to Combinatorial Reasoning, by Anthony Mendes
A Walk Through Combinatorics: An Introduction to Enumeration and Graph Theory, Fourth Edition, by Miklos Bona, World Scientific

Week	Readings	Topics of Discussion
1	Count on It: Introduction, Section 1.1	The combinatorial thought process, elementary enumerative principles: the sum and product principles.
2	Count on It: Section 1.1	Permutations, combinations, applications to probability.
3	Count on It: Section 1.2	Binomial coefficients, binomial expansion theorem.

Week	Readings	Topics of Discussion
4	Count on It: Section 1.2 (continued)	Generalized binomial coefficients, partitions, and applications
5	Count on It: Sections 1.3, 1.4	The inclusion-exclusion principle
6	Count on It: Section 1.4 (continued)	The pigeonhole principle
7	Count on It: Sections 2.1, 2.2	Combinatorial proofs, double counting, bijections
8	Count on It: Section 2.3	Sign reversing involutions
9	Count on It: Section 3.1	Ordinary generating functions, generating function manipulation techniques
10	Count on it: Sections 3.1 (continued), 3.2	Exponential generating functions
11	Count on it: Sections 3.2 (continued), 4.1	Mathematical induction
12	Count on it: Section 4.2	Sequences and recurrence equations
13	A Walk Through Combinatorics: Section 9.1	Introduction to graph theory
14	A Walk Through Combinatorics: Section 9.2	Applications to coding theory
15	To be determined by instructor	Advanced topics selected by instructor

Method of Assessment

The possible methods of assessment are written individual examinations, quizzes, in-class worksheets or 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.