

## ALGEBRA

- MATH 6112: Abstract Algebra II (graduate-level)** Spring 2021  
*Instructors: Sachin Gautam and Joshua Kiers*
- MATH 6111: Abstract Algebra I (graduate-level)** Autumn 2020  
*Instructors: Maria Angelica Cueto and Sjuvon Chung*  
**In progress**
- Main topics covered: group theory, ring theory, module theory, linear and multilinear algebra
  - Course material based on lecture notes given in class
- MATH 5591H: Honors Abstract Algebra II** Spring 2020  
*Instructor: Alexander Leibman*  
**Grade: A**
- Main topics covered: modules, vector spaces, tensor products and direct sums, dual spaces, universal properties, exact sequences, modules over principal ideal domains, fields, polynomials, Galois theory, solvability by radicals
  - Textbook: *Abstract Algebra* by David Dummit and Richard Foote, chapters 10–14
- MATH 5590H: Honors Abstract Algebra I** Autumn 2019  
*Instructor: Alexander Leibman*  
**Grade: A**
- Main topics covered: groups, group actions, Sylow theorems, semidirect products, nilpotent and solvable groups, rings, principal ideal domains, unique factorization domains, algebraic integer rings, polynomials, symmetric functions
  - Textbook: *Abstract Algebra* by David Dummit and Richard Foote, chapters 1–9
- MATH 5520H: Honors Linear Algebra and Differential Equations** Autumn 2018  
*Instructor: Jim Fowler*  
**Grade: A**
- Main topics covered: vector spaces, linear transformations, inner products, determinants, the spectral theorem, matrix decompositions, existence and uniqueness of solutions to various differential equations
  - Textbooks: *Linear Algebra: An Introductory Approach* by Charles Curtis, chapters 1–6 and 9; *An Introduction to Ordinary Differential Equations* by Earl Coddington, chapters 1–5.

## ANALYSIS

- MATH 6212: Real Analysis II (graduate-level)** Spring 2021  
*Instructors: Liz Vivas and Yeor Hafuta*
- MATH 6211: Real Analysis I (graduate-level)** Autumn 2020  
*Instructors: David Penneys and John Johnson*  
**In progress**
- Main topics covered: topology, measures, integration, signed measures and differentiation, elements of functional analysis
  - Textbook: *Real Analysis: Modern Techniques and Their Applications* by Gerald Folland, chapters 1–5 and 7
- MATH 5530H: Honors Probability** Spring 2019  
*Instructor: Neil Falkner*  
**Grade: A**
- Main topics covered: random variables, expectation, independence and conditioning, Poisson and normal distributions,  $\sigma$ -algebras, Lebesgue measure and integration, the monotone convergence theorem, the  $\pi$ - $\lambda$  theorem and monotone class theorem, Poisson processes, martingales and random walks
  - Textbooks: *Elementary Probability Theory* by Kai Lai Chung and Farid AitSahlia, chapters 1–7; lecture notes on topics not covered in the textbook.
- MATH 5522H: Honors Complex Analysis** Spring 2019  
*Instructor: Alexander Leibman*  
**Grade: A**
- Main topics covered: Möbius transformations, plane topology, analytic functions, complex integration, Cauchy's theorem, harmonic functions, sequences of analytic functions, the residue theorem, the Riemann mapping theorem
  - Textbook: *An Introduction to Complex Function Theory*, all chapters
- MATH 4182H: Honors Analysis II** Spring 2018  
*Instructor: Zbigniew Fiedorowicz*  
**Grade: A**
- Main topics covered: metric spaces, point-set topology, topology in  $\mathbb{R}^n$ , differentiation and integration in  $\mathbb{R}^n$ , smooth manifolds and the implicit function theorem, Green's and Stokes's theorems, infinite series, Fourier series
  - Textbook: *Advanced Calculus* by Gerald Folland, all chapters excluding 7
- MATH 4181H: Honors Analysis I** Autumn 2017  
*Instructor: Zbigniew Fiedorowicz*  
**Grade: A**
- Main topics covered: construction of  $\mathbb{R}$ , limits and continuity, differentiation, Riemann integration, trigonometric functions, infinite series (all in  $\mathbb{R}$ )
  - Textbook: *Calculus* by Michael Spivak, chapters 1–24 excluding 16, 17, and 21

## COMBINATORICS AND NUMBER THEORY

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### MATH 7122.01: Analytic Number Theory (*graduate-level*)

Spring 2021

Instructor: Wenzhi Luo

### MATH 7121.01: Algebraic Number Theory (*graduate-level*)

Autumn 2020

Instructor: Stefan Patrikis

**In progress**

- Main topics covered: integrality, discriminants, unique factorization of ideals, finiteness of the class group, the Dirichlet unit theorem, Galois theory and prime factorizations, local fields and their extensions, local and global Kronecker-Weber theorems, introduction to class field theory
- Textbooks: *Algebraic Number Theory* by Jürgen Neukirch, chapters 1–3; *Algebraic Number Theory* by J. S. Milne, all chapters excluding 6

### MATH 5576H: Honors Number Theory

Autumn 2019

Instructor: Vitaly Bergelson

Grade: **A**

- Main topics covered: primes, congruences, quadratic reciprocity, binary quadratic forms, arithmetic functions, diophantine equations, geometry of numbers, Farey fractions, continued fractions, algebraic numbers, rational approximation,  $p$ -adic numbers, elliptic functions, applications of Ramsey theory to number theory, uniform and well-distribution of sequences
- Textbooks: *An Introduction to the Theory of Numbers* by I. Niven, H. Zuckerman, and H. Montgomery, all chapters excluding 8 and 10; assorted handouts from other books including *p-adic Numbers, p-adic Analysis, and Zeta Functions* by Neal Koblitz and *Elliptic Functions* by J. V. Armitage and W. F. Eberlein

### MATH 5529H: Honors Combinatorics

Autumn 2018

Instructor: Vitaly Bergelson

Grade: **A**

- Main topics covered: binomial coefficients, linear recurrences, Catalan numbers, graphs, convex sets in Euclidean space, generating functions, Ramsey theory, van der Waerden's theorem, Szemerédi's theorem, Hindman's theorem, applications of ergodic theory and dynamics to combinatorics, ultrafilters on  $\mathbb{N}$
- Textbooks: *Discrete Mathematics* by L. Lovász, J. Pelikán, and K. Vesztegombi, all chapters excluding 9 and 15; assorted handouts from other books including *Graph Theory* by Reinhard Diestel, *generatingfunctionology* by Herbert Wilf, and *Convex Sets and their Applications* by Stephen Lay

## GEOMETRY AND TOPOLOGY

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### MATH 5801: General Topology and Knot Theory

Spring 2020

Instructor: Sergei Chmutov

Grade: **A**

- Main topics covered: point-set topology, classification of surfaces, homotopy, fundamental groups, covering spaces, group presentations, Seifert-van Kampen theorem, knots and links, torus knots, Wirtinger presentation
- Textbook: *A first course in algebraic topology* by Czes Kosniowski, chapters 1–9, 13–16, and 23–28

### MATH 5540H: Honors Differential Geometry

Spring 2020

Instructor: Neil Falkner

Grade: **A**

- Main topics covered: curves and surfaces, orthogonal linear transformations, the Frenet-Serre apparatus, geodesics, Christoffel symbols, point-set topology, winding numbers, the Jordan curve theorem
- Textbook: *Elements of Differential Geometry* by Richard Millman and George Parker, chapters 1–4; lecture notes on topics not covered in the textbook