Course descriptions, Fall 2025

The following courses are tentatively being offered for the Fall 2025 semester. Descriptions have been given by some instructors, some are from the course catalog; more may be added over time.

MATH 5123. Fourier Transforms

Instructor: Przebinda

(Slashlisted with MATH 4123) Prerequisite: graduate standing and MATH 2443 or 2934, MATH 3113 or MATH 3413, MATH 3333, or permission of the instructor. Fourier series, classical Fourier transform, discrete Fourier transform, distributions and Fourier transforms. Sampling and Shannon's Theorem. No student may earn credit for both 4123 and 5123. (F)

MATH 5173. Advanced Numerical Analysis I

Instructor: Wang, Y

Prerequisite: 4433, 4443 or permission of instructor. Topics may include: error analysis of numerical methods for optimization and initial value problems, numerical approximation of aspects of control problems. (Alt. F)

MATH 5353. Abstract Algebra I

Instructor: Malestein

Prerequisite: 4323, permission of instructor. Groups, Sylow theorems, group actions, group presentations. Rings, ideals, polynomial rings, unique factorization. Fields, algebraic and transcendental extensions. (F)

MATH 5373. Abstract Linear Algebra

Instructor: Przebinda

(Slashlisted with 4373) Prerequisite: 3333. Vector spaces over arbitrary fields, bases, dimension, linear transformations and matrices, similarity and its canonical forms (rational, Jordan), spectral theorem and diagonalization of quadratic forms. No student may earn credit for both 4373 and 5373. (F, Sp)

MATH 5403. Calculus of Variations

Instructor: Wang, W

Prerequisite: 4433 or 3423 or 4163. Linear spaces, global and local theories of optimization, necessary conditions for relative extrema of integrals. (Irreg.)

MATH 5423. Complex Analysis I

Instructor: Albert

Prerequisite: 4433. The complex numbers, topologies of the extended plane and related sphere, elementary functions, power series, properties of general holomorphic functions. The integral of a complex-valued function over an oriented rectifiable curve, the classical theorems on integrals, Taylor and Laurent expansions, analytic continuation, introduction to Riemann surfaces. (Alt. F)

MATH 5453. Real Analysis I

Instructor: Wu

Prerequisite: 4433 or permission of instructor. Lebesgue measure and integration theory, absolutely continuous functions, metric spaces. (F)

MATH 5653. Introduction To Differential Geometry I

Instructor: Patzt

(Slashlisted with MATH 4653) Prerequisite: graduate standing and MATH 2443 or MATH 2934, and MATH 3333, or permission of instructor. Elementary theory of curves and surfaces in three-dimensional Euclidean space, differentiable manifolds, Riemannian geometry of two dimensions, Gauss Theorem Egregium. No student may earn credit for both 4653 and 5653. (F)

MATH 5673. Graph Theory I

Instructor: Ozaydin

(Slashlisted with 4673) Prerequisite: 2513 or permission of instructor. An introduction to the theory of graphs. Topics include basic definitions, cutpoints, blocks, trees, connectivity and Menger's theorem. No student may earn credit for both 4673 and 5673. (F)

MATH 5693. Topics in Geometry and Combinatorics I
Instructor: Apanasov

Text: ”The Shape of Space” by Jeffrey Weeks, 3rd edition & ”The Geometry of Discrete groups” by Alan Beardon, Springer GTM 91 (optional) & ”Dynamics of Discrete Group Action” by Boris Apanasov, De Gruyter Advances in Analysis and Geometry 10, 2024.

COURSE CONTENT AND COURSEWORK: we will explore interconnected topics: geometry of manifolds, dynamics of discrete action of their fundamental groups, combinatorics of related space tessellations (”Lego Land”), and geometric analysis. We will start with basics of topology on surfaces and manifolds, the Euclidean geometry and geometry

of the sphere. Then we will study models of the real (& complex) hyperbolic geometry. These geometries and their tessellations by ”fundamental sets” are used for description of locally homogenious surfaces and manifolds whose ”fundamental groups” isometrically act on their universal covering spaces, with appropriate tesselations.
In a parallel way to my lectures students will study the ”The Shape of Space” material, bridging it to the material of lectures. Such self studies (in a form of research projects) will culminate in class presentations which will be used in lieu of the final exam (with grading based on peer evaluations after presentations). Additionally, students will work on homework problems. The day-to-day lectures and discussions form the background of this course, so routine attendance is essential for this class.

MATH 5853. Topology I
Instructor: Forester

Prerequisite: 2433 and 2513. Set theory, separation axioms, connectedness, compactness, continuity, metric spaces, nets and sequences. (F)

MATH 5920. Seminar--Algebra and Theory of Numbers.1-2 Credit Hours.

1 to 2 hours. Prerequisite: permission of instructor. May be repeated with change of content; maximum credit 12 hours. (F, Sp)

MATH 5930. Seminar--Geometry and Topology.1-2 Credit Hours.

1 to 2 hours. Prerequisite: permission of instructor. May be repeated with change of content; maximum credit 12 hours. (F, Sp)

MATH 6333. Lie Theory I

Instructor: Muller

Prerequisites: 5363 and 5863 or permission of the instructor. Basic properties of Lie algebras, nilpotent and solvable Lie algebras, semi-simple Lie algebras, root systems and classification theorems. (Irreg.)

MATH 6393. Topics in Algebra

Instructor: Lorincz

Prerequisite: 5353 or permission of instructor. May be repeated with change of content; maximum credit 15 hours. Topics of modern research interest in algebra. (Irreg.)

MATH 6673. Differential Geometry I

Instructor: Malestein

Prerequisite: 5853 or permission of instructor. Multilinear algebra, differential manifolds, exterior differential forms, affine connections, Riemannian manifolds. (F)

MATH 6833. Topics in Topology I
Instructor: He

The course covers topics on hyperbolic structures on surfaces and geodesic currents. We will start with the basics and work towards describing Bonahon's construction of Thurston's compactification of Teichmuller spaces.

MATH 6910. Seminar--Analysis.1-2 Credit Hours.

1 to 2 hours. Prerequisite: permission of the instructor. May be repeated with change of content; maximum credit 15 hours. Seminar on analysis and applied mathematics topics. (F, Sp)