

COURSE DESCRIPTIONS (SPRING 2027)

The following courses are (tentatively) being offered for the Fall 2026 semester. Descriptions have been given by some instructors; more may be added over time. Note that slashlisted courses, quals courses, and topics courses have been collected separately in this document for your convenience.

COURSES

(MATH 5103) Mathematical Models

Instructor: Weinan Wang

Official Catalog Description: Prerequisite: permission of instructor or admission to the M.S. program. May be repeated with change of content; maximum credit six hours. Mathematical models are formulated for problems arising in various areas in which mathematics has been applied. In each case, techniques are developed for analyzing the resulting mathematical problem, and this analysis is used to test the validity of the model.

(MATH 5163) Partial Differential Equations

Instructor: John P. Albert

Official Catalog Description: Prerequisite: 4163 or permission of instructor. First order equations, Cauchy problem for higher order equations, second order equations with constant coefficients, linear hyperbolic equations.

(MATH 5263) Issues/Problems-Math Pedagogy

Instructor: Sepideh Stewart

Description from Instructor: In this course, we will read and discuss a selection of classic mathematics education papers. For most students, this will introduce them to the field's scholarship, especially related to the teaching and learning of university mathematics. This course is intended for both mathematics and mathematics education students interested in foundational work in the field.

(MATH 6383) Algebraic Geometry

Instructor: Roi Docampo

Description from Instructor: At its core, Algebraic Geometry is the study of systems of polynomial equations. Its roots date back to the ancient Greek mathematicians, and today it has become one of the pillars of pure mathematics. Its ideas and techniques appear frequently in many different fields in mathematics and beyond (algebra, differential geometry, topology, analysis, number theory, mathematical physics, and more). The goal of the course is to give an introduction to Algebraic Geometry for graduate students. We will emphasize the theoretical foundations while also exploring a wide collection of examples in detail.

Concrete topics include: algebraic sets and varieties, Zariski topology, the Nullstellensatz, projective spaces and varieties, Bezout's theorem, rational functions and rational maps, dimension theory, singular and non-singular varieties, tangent and cotangent spaces, the Bertini theorems. If time permits, and depending on the interests of the participants, we might also discuss: basic theory of algebraic curves, basic theory of algebraic surfaces, cohomology of projective varieties, and Groebner bases.

We will loosely follow several of the standard introductory texts in the subject: "Basic Algebraic Geometry", by Shafarevich; "Algebraic Geometry: a first course", by Harris; "An Invitation to Algebraic Geometry", by Smith, Kahanpaa, Kekalainen and Traves; "Algebraic Curves", by Fulton; "Notes on Algebraic Geometry", by Gathman; and "Algebraic Geometry", by Hartshorne.

(MATH 6483) Functional Analysis II

Instructor: Javier Alejandro Chavez Dominguez

Official Catalog Description: Prerequisite: 6473. Banach algebras and harmonic analysis, representations of symmetric rings, unitary representations of a group, rings of operators in Hilbert space, decomposition of ring operators. Introduction to the theory of distributions.

(MATH 6823) Algebraic Topology II

Instructor: Alex Mramor

Official Catalog Description: Prerequisite: 6813. Topics in cohomology and homology theory, universal coefficient theorems, orientation and duality on manifolds. Further topics may include: obstruction theory, cohomology operations, fibre bundles and characteristic classes, theory of sheaves, Eilenberg-MacLane spaces and Postnikov systems, spectral sequences.

SLASHLISTED COURSES

A *slashlisted course* is a single course offered under two different numbers: a 4000-level for undergraduates and a 5000-level for graduates. Graduate students must enroll in the 5000-level version to earn credit towards their degree and should therefore expect to complete additional material beyond students enrolled in the 4000-level version.

(MATH 5373) Abstract Linear Algebra

Instructor: Sepideh Stewart

Official Catalog Description: (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.

(MATH 5383) Applied Modern Algebra

Instructor: Gregory Muller

Official Catalog Description: (Slashlisted with MATH 4383) Prerequisite: MATH 3333. Topics from the theory of error correcting codes, including Shannon's theorem, finite fields, families of linear codes such as Hamming, Golay, BCH, and Reed-Solomon codes. Other topics such as Goppa codes, group codes, and cryptography as time permits. No student may earn credit for both 4383 and 5383.

(MATH 5443) Introduction to Analysis II

Instructor: Javier Alejandro Chavez Dominguez

Official Catalog Description: (Slashlisted with 4443) Prerequisite: 4433. Integration of functions of a single variable. Series of real numbers. Series of functions. Differentiation of functions of more than one variable. No student may earn credit for both 4443 and 5443.

(MATH 5743) Intro to Math Statistics

Instructor: Christian Remling

Official Catalog Description: (Slashlisted with 4743) Prerequisite: 4733. Mathematical development of basic concepts in statistics: estimation, hypothesis testing, sampling from normal and other populations; regression, goodness of fit. No student may earn credit for both 4743 and 5743.

CORE COURSES

These are the three sequences offered each year on the three qualifying exam topics.

(MATH 5363) Abstract Algebra II

Instructor: Andras Lorincz

Official Catalog Description: Prerequisite: 5353. Galois theory, solvability. Modules over a principal ideal domain. Noetherian ideal theory. Group representations, semisimple rings. Classical groups

(MATH 5463) Real Analysis II

Instructor: Christian Remling

Official Catalog Description: Prerequisite: 5453. General measure and integration theory, Banach spaces, topics from related areas.

(MATH 5863) Topology II

Instructor: Michael R Jablonski

Official Catalog Description: Prerequisite: 5853. Metrization, product and quotient spaces, function spaces, dimension theory, Hilbert spaces, homotopy, simplicial complexes, continua.

TOPICS COURSES

Topics courses cover material at the discretion of the instructor. Two topics courses with the same name and number may cover significantly different material in different semesters. Topics courses may be repeated for credit; however, each course number has a limit on how many times it can be taken for credit.

Literacy courses are a special type of topics courses which are co-taught by three professors. Each professor teaches one-third of the semester on a topic of their choice.

(MATH 5803) Topics in Mathematics

Instructor: Tomaz Przebinda

Description from Instructor: Quantum information theory is a rapidly growing field that aims to exploit the laws of quantum mechanics to design fundamentally new approaches to computation and communication. It has a tremendous impact on applied science. For example, Shor's algorithm for factoring large numbers, published in 1994, threatens the RSA cryptosystem and prompted the sell of RSA Data Security founded by Rivest, Shamir, and Adelman in 1996. In the last decade some of the leading global tech corporations including IBM, Microsoft, and Google have followed the lead of Canadian startup D-Wave Systems and are investing significant resources into the development of quantum computing hardware. The aim of this course is to study the basic quantum algorithms, that is the algorithms that could be run on a quantum computer. They are interesting in their own right, but the likelihood of a quantum computer being build in a near future is increasing. No background beyond basic linear algebra is required

(MATH 6803) Literacy in Topology

Instructor: Max Forester, Justin Malestein, Alex Mramor

Official Catalog Description: Prerequisite: Graduate standing and MATH 5863; May be repeated with change of content; maximum credit 15 hours. This course will cover three independent advanced topics in the general area of Topology. Some past topics have included: Mostow rigidity; group cohomology; curvature and topology; Morse theory; ergodicity of geodesic flow; Bass-Serre theory; deRham cohomology; introduction to mapping class groups; K-theory; geometry of metric spaces; the homeomorphism group of the circle; topology of 3-manifolds.