MATHEMATICS (MATH)

MATH 95 — FUNDAMENTAL MATHEMATICAL SKILLS
3 credits.
Covers the fundamental mathematics necessary both as survival skills in daily life and as tool for success in college. Includes arithmetic procedures and their applications. Intended for students fulfilling the remediation requirements in mathematics. Open to Fr
Requisites: Remedial status as determined by the University; does not count for degree credit.
Repeatable for Credit: No

MATH 201 — PREPARATORY ALGEBRA
3 credits.
Covers the necessary mathematical tools needed to succeed in our algebra course and provides fundamental mathematical skills. Topics include real numbers, linear equations and inequalities, integral and fractional exponents, polynomials and their arithmetic, polynomial equations and equations with fractional exponents, the quadratic formula and completing the square, systems of two linear equations, graphing, and problem solving using algebra and graphs. All students must pass an assessment on the basic mathematical skills to complete the course. The course does not count for degree credit. Department consent required to drop/swap from course
Requisites: Placement in MATH 096.
Repeatable for Credit: No

MATH 112 — ALGEBRA
3 credits.
Polynomial equations, remainder and factor theorems, functions, graphs of functions, simultaneous linear equations, logarithm and exponential functions, sequences and series, mathematical induction, binomial theorem. MATH 118 does not fulfill the prerequisite
Requisites: MATH 096 or placement into MATH 112.
Course Designation: Gen Ed - Quantitative Reasoning Part A
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 113 — TRIGONOMETRY
3 credits.
This course covers the graphs, properties and geometric significance of trigonometric functions of a real variable. Other topics include trigonometric equations and identities, application, trigonometric form of complex numbers, DeMoivre's theorem, and polar and parametric equations. The course also has a significant number of applications, especially related to other disciplines.
Requisites: MATH 112 or placement into MATH 113
Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 114 — ALGEBRA AND TRIGONOMETRY
5 credits.
Covers MATH 112 and MATH 113. Not recommended for students with less than an AB in Math 101. MATH 118 does not fulfill the prerequisite
Requisites: MATH 096 or placement into MATH 114 or 171.
Course Designation: Gen Ed - Quantitative Reasoning Part A
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 118 — SUMMER COLLEGIATE EXPERIENCE MATHEMATICS COURSE
2 credits.
A preparation and introductory math course for students enrolled in the Summer Collegiate Experience program. The course will include material from precalculus and calculus and related topics depending on students' results on the math placement exam. Open to Freshmen only
Requisites: Student must be enrolled in the Summer Collegiate experience program and have consent of the math SCE coordinator.
Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Summer 2016

MATH 130 — MATHEMATICS FOR TEACHING: NUMBERS AND OPERATIONS
3 credits.
Mathematics for teaching focusing on numbers and operations in K-8. Emphasis on understanding a variety of problem-solving strategies and word problems. Content will focus on place value, models for the operations, standard and alternative algorithms, fractions, and decimals. MATH 118 does not fulfill the prerequisite
Requisites: MATH 096 or placement into MATH 112 and Elementary Education or Special Education classification.
Course Designation: Gen Ed - Quantitative Reasoning Part A
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 131 — MATHEMATICS FOR TEACHING: GEOMETRY AND MEASUREMENT
3 credits.
Mathematics for teaching focusing on geometry and measurement in K-8. Emphasis on understanding a variety of problem-solving strategies and deductive reasoning. Content will focus on geometric shapes and their relationships, transformations, measurement, and the connection to numbers.
Requisites: Grade of C in MATH 130; and Elementary Education or Special Education classification
Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
MATH 132 — PROBLEM SOLVING IN ALGEBRA, PROBABILITY AND STATISTICS
3 credits.

Algebra, probability, and statistics for teachers of elementary school mathematics. Topics include proportions, relations, functions and their graphs, equally likely outcomes, expected value, and representation of data. The emphasis is on problem solving, modeling, and analysis of solution strategies. MATH 130 131 with a grade of C or better (or exemption from MATH 130 and/or 131). Open only to sstdts in specific educ programs (PRE, PSR, EED, SPE) or by permission of Educ Acad Srvcs

Requisites: Open to Freshmen.

Course Designation: Gen Ed - Quantitative Reasoning Part B
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 135 — ALGEBRAIC REASONING FOR TEACHING MATH
3 credits.

Topics from high school/college algebra relevant to teaching mathematics in middle school, including linear and quadratic equations and inequalities, linear systems, concept of a function, exponential and polynomial functions, with an emphasis on problem solving and modeling.

Requisites: Grade of C in MATH 130, and (MATH 112, 114, or 171), and classified in Elementary Education or Special Education

Course Designation: Gen Ed - Quantitative Reasoning Part B
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 136 — PRE-CALCULUS AND CALCULUS FOR MIDDLE SCHOOL TEACHERS
6 credits.

Course designed to develop future middle school mathematics teachers' knowledge of precalculus and calculus concepts and to make connections between these concepts and middle school mathematics.

Requisites: Grade of C MATH 135; and Elementary Education or Special Student classification

Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

Last Taught: Fall 2017

MATH 138 — MATHEMATICS FOR TEACHING: CONJECTURE, GENERALIZATION, AND PROOF
3 credits.

Explores the roles of conjecture, generalization, and proof in effective teaching of mathematics. Students explore mathematical reasoning as an iterative process of conjecturing, generalizing and investigating. Topics are drawn from counting, probability, statistics, arithmetic, algebra, and geometry.

Requisites: Grade of C in MATH 136; and Elementary Education classification

Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 141 — QUANTITATIVE REASONING AND PROBLEM SOLVING
3 credits.

Quantitative reasoning for students who need to satisfy part A of the Quantitative Reasoning requirement and prepare for QR-B courses, but do not want to continue in the calculus sequence. MATH 118 does not fulfill the prerequisite

Requisites: MATH 096 or placement into MATH 141.

Course Designation: Gen Ed - Quantitative Reasoning Part A
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 171 — CALCULUS WITH ALGEBRA AND TRIGONOMETRY I
5 credits.

Topics in algebra, trigonometry and precalculus are integrated with elementary differential calculus. Part of a 2-semester sequence with MATH 217; these two courses together are equivalent to MATH 114 and 221. Not recommended for students with less than an A8 in Math 101.

MATH 118 does not fulfill the prerequisite

Requisites: MATH 096 or placement into MATH 114 or 171.

Course Designation: Gen Ed - Quantitative Reasoning Part A
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

Last Taught: Fall 2017

MATH 198 — DIRECTED STUDY
1-3 credits.

Requisites: Consent of instructor

Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 207 — TOPICS IN MATHEMATICS STUDY ABROAD
1-5 credits.

Credit is awarded to students who have completed an appropriate math course abroad at the intermediate level having no direct equivalence within the math department offerings. The study abroad course must be pre-approved by the math department.

Requisites: Enrollment in a resident study abroad progm approval of the math dept

Course Designation: Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
MATH 210 — TOPICS IN FINITE MATHEMATICS
3 credits.
Topics in finite mathematics including elementary matrix algebra, linear programming, introduction to probability, and mathematics of finance. Students planning to take both MATH 210 and MATH 211 are advised to take MATH 210 first. Primarily for students in social and biological science and prebusiness. Students preparing for advanced study in mathematics should take MATH 221-222-223 rather than MATH 210-211-213. Open to Freshmen
Requisites: Adv math competency--algebra and suitable placement scores or MATH 112 or 114.
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2012

MATH 211 — CALCULUS
5 credits.
Essential concepts of differential and integral calculus; exponential and logarithmic functions; functions of several variables. Primarily for students in prebusiness and some social sciences. Students preparing for advanced study in mathematics, physics, engineering and other sciences should take MATH 221-222-234 rather than MATH 210-211-213. Most students in the biological sciences should take MATH 221. The course MATH 210 is not a prerequisite for MATH 211.
Requisites: MATH 112 or MATH 114 or placement into MATH 211
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 213 — CALCULUS AND INTRODUCTION TO DIFFERENTIAL EQUATIONS
3 credits.
Techniques of integration, multiple integrals, infinite sequences and series, first order differential equations, two-dimensional systems of differential equations, difference equations, with models from and applications in business and the social and biological sciences.
Requisites: MATH 211, MATH 217, MATH 221, or MATH 275
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 217 — CALCULUS WITH ALGEBRA AND TRIGONOMETRY II
5 credits.
Continuation of MATH 171. Topics in algebra, trigonometry and precalculus are integrated with elementary differential calculus. Completion of MATH 217 implies completion of MATH 21 and MATH 114.
Requisites: MATH 171
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 1995

MATH 221 — CALCULUS AND ANALYTIC GEOMETRY 1
5 credits.
Introduction to differential and integral calculus and plane analytic geometry; applications; transcendental functions.
Requisites: MATH 113, 114, or placement in MATH 221
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 222 — CALCULUS AND ANALYTIC GEOMETRY 2
4 credits.
Techniques of integration, improper integrals, first order ordinary differential equations, sequences and series, Taylor series, vector geometry in two and three dimensions.
Requisites: MATH 217, 221, or 275
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 228 — WES CALCULUS SUPPLEMENT
2 credits.
Topics in algebra, trigonometry, differential, integral and multi-variable calculus and analytic geometry will be covered depending on which calculus course MATH 228 is attached to. MATH 228 must be taken in conjunction with the appropriate WES section of MATH 171 or 217 or 221 or 222 or 234.
Requisites: Member of Wisconsin Emerging Scholars--MATH Program
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
**MATH 234 — CALCULUS—FUNCTIONS OF SEVERAL VARIABLES**  
4 credits.  
Introduction to calculus of functions of several variables; calculus on parameterized curves, derivatives of functions of several variables, multiple integrals, vector calculus.  
**Requisites:** MATH 222 or 276  
**Course Designation:** Breadth - Natural Science  
Level - Intermediate  
L&S Credit - Counts as Liberal Arts and Science credit in L&S  
**Repeatable for Credit:** No  

**MATH/COMP SCI 240 — INTRODUCTION TO DISCRETE MATHEMATICS**  
3 credits.  
**Requisites:** MATH 217, 221, or 275  
**Course Designation:** Breadth - Natural Science  
Level - Intermediate  
L&S Credit - Counts as Liberal Arts and Science credit in L&S  
**Repeatable for Credit:** No  

**MATH 275 — TOPICS IN CALCULUS I**  
5 credits.  
Topics in first semester calculus. This is the first semester of the calculus honors sequence. Satisfied Quantitative Reasoning (QR) A requirement  
**Requisites:** Course is available by invitation only for freshmen students who placed into MATH 221.  
**Course Designation:** Gen Ed - Quantitative Reasoning Part B  
Breadth - Natural Science  
Level - Intermediate  
L&S Credit - Counts as Liberal Arts and Science credit in L&S  
**Repeatable for Credit:** No  
**Last Taught:** Fall 1994  

**MATH 276 — TOPICS IN CALCULUS II**  
5 credits.  
Topics in second semester calculus. This is the second semester of the calculus honors sequence. It is intended for students who completed MATH 275. Satisfied Quantitative Reasoning (QR) A requirement  
**Requisites:** Either MATH 275 or MATH 221 and consent of instructor.  
**Course Designation:** Gen Ed - Quantitative Reasoning Part B  
Breadth - Natural Science  
Level - Intermediate  
L&S Credit - Counts as Liberal Arts and Science credit in L&S  
**Repeatable for Credit:** No  
**Last Taught:** Spring 2015  

**MATH 298 — DIRECTED STUDY IN MATHEMATICS**  
1-3 credits.  
**Requisites:** Consent of instructor  
**Course Designation:** Level - Intermediate  
L&S Credit - Counts as Liberal Arts and Science credit in L&S  
**Repeatable for Credit:** Yes, unlimited number of completions  

**MATH/ACT SCI 303 — THEORY OF INTEREST AND LIFE INSURANCE**  
3 credits.  
Application of calculus to compound interest and insurance functions; interest compounded discretely and continuously; force of interest function; annuities payable discretely and continuously; bonds and yield rates; life tables, life annuities, single and annual premiums for insurance and annuities; reserves.  
**Requisites:** MATH 222 or 276  
**Course Designation:** Breadth - Natural Science  
Level - Intermediate  
L&S Credit - Counts as Liberal Arts and Science credit in L&S  
**Repeatable for Credit:** No  

**MATH/STAT 309 — INTRODUCTION TO PROBABILITY AND MATHEMATICAL STATISTICS I**  
3 credits.  
Probability and combinatorial methods, discrete and continuous, univariate and multivariate distributions, expected values, moments, normal distribution and derived distributions, estimation.  
**Requisites:** MATH 234 or concurrent enrollment; not open to students who have taken MATH/STAT/MATH 431 or STAT 311  
**Course Designation:** Breadth - Natural Science  
Level - Advanced  
L&S Credit - Counts as Liberal Arts and Science credit in L&S  
**Repeatable for Credit:** No  

**MATH/STAT 310 — INTRODUCTION TO PROBABILITY AND MATHEMATICAL STATISTICS II**  
3 credits.  
This course in mathematical statistical inference aims at providing an understanding of likelihood’s central role to statistical inference, using the language of mathematical statistics to analyze statistical procedures, and using the computer as a tool for understanding statistics. Specific topics include: samples and populations, estimation, hypothesis testing, and theoretical properties of statistical inference.  
**Requisites:** (MATH/STAT/MATH 309, STAT 311, or MATH/STAT/MATH 431) and (STAT 224, STAT 301, STAT 302, STAT 324, STAT 371, or ECON 310); or graduate standing  
**Course Designation:** Breadth - Natural Science  
Level - Advanced  
L&S Credit - Counts as Liberal Arts and Science credit in L&S  
**Repeatable for Credit:** No  

**MATH 319 — TECHNIQUES IN ORDINARY DIFFERENTIAL EQUATIONS**  
3 credits.  
Review of linear differential equations; series solution of linear differential equations; boundary value problems; Laplace transforms; possibly numerical methods and two dimensional autonomous systems.  
**Requisites:** MATH 222 or 276  
**Course Designation:** Breadth - Natural Science  
Level - Advanced  
L&S Credit - Counts as Liberal Arts and Science credit in L&S  
**Repeatable for Credit:** No
MATH 320 — LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS
3 credits.
Introduction to linear algebra, including matrices, linear transformations, eigenvalues and eigenvectors. Linear systems of differential equations. Numerical aspects of linear problems. Prospective math majors should instead consider MATH 341 for a proof based introductory linear algebra course.
Requisites: MATH 222 or 276
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 321 — APPLIED MATHEMATICAL ANALYSIS
3 credits.
Vector analysis: algebra and geometry of vectors, vector differential and integral calculus, theorems of Green, Gauss, and Stokes; complex analysis: analytic functions, complex integrals and residues, Taylor and Laurent series.
Requisites: MATH 234 and (MATH 319, 320, 340, 341 or 375)
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 322 — APPLIED MATHEMATICAL ANALYSIS
3 credits.
Sturm-Liouville theory; Fourier series, including mean convergence; boundary value problems for linear second order partial differential equations, including separation of variables and eigenfunction expansions.
Requisites: MATH 321 or 376
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 331 — AN INTRODUCTION TO PROBABILITY AND MARKOV CHAIN MODELS
3 credits.
An overview of basic probability including discrete and continuous random variables, moment generating functions, limit theorems, conditional probability and expectations, random walks, and Markov chains.
Requisites: MATH 234 or MATH 222 240
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 340 — ELEMENTARY MATRIX AND LINEAR ALGEBRA
3 credits.
Matrix algebra, linear systems of equations, vector spaces, sub-spaces, linear dependence, rank of matrices, determinants, linear transformations, eigenvalues and eigenvectors, diagonalization, inner products and orthogonal vectors, symmetric matrices. Prospective math majors should instead consider MATH 341 for a proof based introductory linear algebra course. Not open to students with credit for MATH 341 or 375.
Requisites: MATH 222.
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 341 — LINEAR ALGEBRA
3 credits.
This course emphasizes the understanding of concepts in linear algebra and teaches to write and understand proofs in mathematics in general and in linear algebra in particular. Not open to students who have credit for MATH 375.
Requisites: MATH 234.
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 375 — TOPICS IN MULTI-VARIABLE CALCULUS AND LINEAR ALGEBRA
5 credits.
Vector spaces and linear transformations, differential calculus of scalar and vector fields, determinants, eigenvalues and eigenvectors, multiple integrals, line integrals, and surface integrals.
Requisites: MATH 276
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2017

MATH 376 — TOPICS IN MULTI-VARIABLE CALCULUS AND DIFFERENTIAL EQUATIONS
5 credits.
Topics in Multi-variable calculus and introduction to differential equiations. A total of only 10 credits can be received when all three of the courses MATH 234, 375, 376 are taken. Open to Fr
Requisites: MATH 375 or cons inst.
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
MATH 407 — TOPICS IN MATHEMATICS STUDY ABROAD
1-5 credits.

Credit is awarded to students who have completed an appropriate math course abroad at the advanced level having no direct equivalence within the math department offerings. The study abroad course must be pre-approved by the math department.

Requisites: Enrollment in a resident study abroad progm approval of the math dept

Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions

MATH 415 — APPLIED DYNAMICAL SYSTEMS, CHAOS AND MODELING
3 credits.

An introduction to nonlinear dynamical systems including stability, bifurcations and chaos. The course will give underlying mathematical ideas, but emphasize applications from many scientific fields.

Requisites: MATH 319 or 320 or 376

Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2017

MATH 421 — THE THEORY OF SINGLE VARIABLE CALCULUS
3 credits.

This course covers material in first and second semester calculus but it is intended to teach math majors to write and understand proofs in mathematics in general and in calculus in particular.

Requisites: MATH 234

Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

MATH/COMP SCI/ECE 425 — INTRODUCTION TO COMBINATORIAL OPTIMIZATION
3 credits.

Focuses on optimization problems over discrete structures, such as shortest paths, spanning trees, flows, matchings, and the traveling salesman problem. We will investigate structural properties of these problems, and we will study both exact methods for their solution, and approximation algorithms.

Requisites: (MATH 320, 340, 341, or 375) or graduate or professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

MATH/STAT 431 — INTRODUCTION TO THE THEORY OF PROBABILITY
3 credits.

Topics covered include axioms of probability, random variables, the most important discrete and continuous probability distributions, expectation and variance, moment generating functions, conditional probability and conditional expectations, multivariate distributions, Markov’s and Chebyshev’s inequalities, laws of large numbers, and the central limit theorem.

Requisites: MATH 234 or 376

Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

MATH/COMP SCI/ECE 435 — INTRODUCTION TO CRYPTOGRAPHY
3 credits.

Cryptography is the art and science of transmitting digital information in a secure manner. This course will provide an introduction to its technical aspects.

Requisites: MATH 320, 340, 341, or 375

Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

MATH 441 — INTRODUCTION TO MODERN ALGEBRA
3 credits.

The integers, emphasizing general group and ring properties. Permutation groups, symmetry groups, polynomial rings, leading to notions of abstract groups and rings. Congruences, computations, including finite fields and applications. Emphasis on concepts and concrete examples and computations, not complicated proofs. Students who have taken MATH 541 are not eligible to enroll for this class.

Requisites: MATH 340 or MATH 341 Required.

Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

MATH 443 — APPLIED LINEAR ALGEBRA
3 credits.

Review of matrix algebra. Simultaneous linear equations, linear dependence and rank, vector space, eigenvalues and eigenvectors, diagonalization, quadratic forms, inner product spaces, norms, canonical forms. For students whose main field of interest is not pure mathematics. Discussion of numerical aspects and applications in the sciences.

Requisites: MATH 320, 340, 341, or 375

Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2017
Mathematics (MATH)

MATH 461 — COLLEGE GEOMETRY I
3 credits.

An introduction to Euclidean or non-Euclidean geometry at the college level.
Requisites: MATH 234 or (MATH 222 and MATH/COMP SCI/MATH 240) or MATH 375
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH/CURRIC 471 — MATHEMATICS FOR SECONDARY SCHOOL TEACHERS
3 credits.

This is a capstone course for future middle and high school teachers, drawing connections between higher mathematics and school mathematics.
Requisites: MATH 341 or MATH 375 or MATH 421, and MATH 461
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH/HIST SCI 473 — HISTORY OF MATHEMATICS
3 credits.

An historical survey of the main lines of mathematical development.
Requisites: Consent of instructor
Course Designation: Breadth - Either Humanities or Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH/COMP SCI/STAT 475 — INTRODUCTION TO COMBINATORICS
3 credits.

Requisites: (MATH 320, 340, 341, or 375) or graduate or professional standing
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 490 — UNDERGRADUATE SEMINAR
1-3 credits.

Problem solving techniques.
Requisites: So st and cons inst
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2018

MATH 491 — TOPICS IN UNDERGRADUATE MATHEMATICS
3 credits.

Topics will vary.
Requisites: Math 223 or 234 cons inst
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2016

MATH/COMP SCI 513 — NUMERICAL LINEAR ALGEBRA
3 credits.

Requisites: (MATH 340, 341, or 375) and (COMP SCI 200, 300, 301, 302 or 310) or graduate or professional standing
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH/COMP SCI 514 — NUMERICAL ANALYSIS
3 credits.

Requisites: MATH 340 and (COMP SCI 200, 300, 301, or 310) or graduate or professional standing
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

MATH 519 — ORDINARY DIFFERENTIAL EQUATIONS
3 credits.

Provides a rigorous introduction to ordinary differential equations and dynamical systems. Intended for math majors and advanced (or graduate) students in other disciplines.
Requisites: MATH 319 or 320 or 340, MATH 421 or 521; or cons inst
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
MATH 521 — ANALYSIS I
3 credits.

The real numbers, elements of set theory, metric spaces and basic topology, sequences and series, limits, continuity, differentiation, integration, sequences and series of functions, uniform convergence.

Requisites: MATH 341 or 375 or 421
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 522 — ANALYSIS II
3 credits.

Special functions, power series, Fourier series, approximation, contraction principle, characterizations of compactness in metric spaces, applications to differential equations. Differential calculus in normed spaces, including implicit and inverse function theorems. Course is essential for graduate work in mathematics.

Requisites: MATH 521, a course in linear algebra (can be taken concurrently) or cons inst
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH/COMP SCI/I SY E/STAT 525 — LINEAR PROGRAMMING METHODS
3 credits.

Real linear algebra over polyhedral cones; theorems of the alternative for matrices. Formulation of linear programs. Duality theory and solvability. The simplex method and related methods for efficient computer solution. Perturbation and sensitivity analysis. Applications and extensions, such as game theory, linear economic models, and quadratic programming.

Requisites: (MATH 320, 340, 341, 375, or 443) or graduate or professional standing
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 531 — PROBABILITY THEORY
3 credits.

The course is a rigorous introduction to probability theory at an advanced undergraduate level. Only a minimal amount of measure theory is used, in particular, the theory of Lebesgue integrals is not needed. It is aimed at math majors and Master's degree students, or students in other fields who will need probability in their future careers. The course gives an introduction to the basics (Kolmogorov axioms, conditional probability and independence, random variables, expectation) and discusses some classical results with proofs (DeMoivre-Laplace limit theorems, the study of simple random walk on the one dimensional lattice, applications of generating functions).

Requisites: MATH 375, 421, or 521
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 541 — MODERN ALGEBRA
3 credits.

Groups, normal subgroups, Cayley's theorem, rings, ideals, homomorphisms, polynomial rings, abstract vector spaces.

Requisites: MATH 341 or MATH 375 or (MATH 421 and MATH 320) or (MATH 421 and MATH 340)
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 542 — MODERN ALGEBRA
3 credits.

Field extensions, roots of polynomials, splitting fields, simple extensions, linear transformations, matrices, characteristic roots, canonical forms, determinants.

Requisites: MATH 541
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 551 — ELEMENTARY TOPOLOGY
3 credits.

Topological spaces, connectedness, compactness, separation axioms, metric spaces.

Requisites: MATH 341 or MATH 375 or (MATH 421 and MATH 320) or (MATH 421 and MATH 340)
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 552 — ELEMENTARY GEOMETRIC AND ALGEBRAIC TOPOLOGY
3 credits.

Introduction to algebraic topology. Emphasis on geometric aspects, including two-dimensional manifolds, the fundamental group, covering spaces, basic simplicial homology theory, the Euler-Poincare formula, and homotopy classes of mappings.

Requisites: MATH 551 and 542
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

Last Taught: Spring 2016
MATH 561 — DIFFERENTIAL GEOMETRY
3 credits.

Theory of curves and surfaces by differential methods.
Requisites: MATH 320 or 340; and MATH 521
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 567 — ELEMENTARY NUMBER THEORY
3 credits.

Fundamental theorem of arithmetic, quadratic residues and quadratic reciprocity, number-theoretic functions, certain diophantine equations, Farey fractions, continued fractions.
Requisites: MATH 340 or con reg
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

MATH 570 — FUNDAMENTALS OF SET THEORY
3 credits.

Students will be introduced to the basic concepts of Set Theory including: Set-theoretical paradoxes and means of avoiding them, sets, relations, functions, orders and well-orders, proof by transfinite induction and definitions by transfinite recursion, cardinal and ordinal numbers and their arithmetic, construction of the real numbers, the axiom of choice and its consequences.
Requisites: MATH 341, 375, 376, or 421
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

MATH/PHILOS 571 — MATHEMATICAL LOGIC
3 credits.

Basics of logic and mathematical proofs; propositional logic; first order logic; undecidability.
Requisites: MATH 340 or 341 or 375
Course Designation: Breadth - Either Humanities or Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

MATH 605 — STOCHASTIC METHODS FOR BIOLOGY
3 credits.

Intended to provide a rigorous foundation for stochastic modeling of biological systems. The mathematical emphasis is in stochastic analysis and simulation. Biological applications include epidemiological phenomena, biochemical reaction networks and population dynamics. Some basic linear algebra is also recommended
Requisites: Math/STAT/MATH 431; Math/STAT/MATH 309 or STAT 311; or cons inst.
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH/B M I/BIOCHEM/BMOLCHEM 606 — MATHEMATICAL METHODS FOR STRUCTURAL BIOLOGY
3 credits.

Intended to provide a rigorous foundation for mathematical modeling of biological structures. Mathematical techniques include ordinary and partial differential equations, 3D Fourier analysis and optimization. Biological applications include protein folding, molecular dynamics, implicit solvent electrostats, and molecular interactions.
Requisites: (MATH 234 or 320) and (COMP SCI 301 or 302)
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

MATH 607 — TOPICS IN MATHEMATICS STUDY ABROAD
1-5 credits.

Credit is awarded to students who have completed an appropriate math course abroad at the advanced level having no direct equivalence within the math department offerings. The study abroad course must be pre-approved by the math department.
Requisites: Enrollment in a resident study abroad progm approval of the math dept
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions

MATH 608 — MATHEMATICAL METHODS FOR CONTINUUM MODELING IN BIOLOGY
3 credits.

Intended to provide a rigorous foundation for mathematical modeling of biological systems. The mathematical emphasis is on partial differential equations, particularly reaction-diffusion and transport equations. Biological applications include bacterial chemotaxis, spatio-temporal ecological dynamics, and cell-level reactions.
Requisites: MATH 322; MATH 415; MATH/COMP SCI 514, or cons inst
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
MATH/B M I/BIOCHEM/BMOLCHEM 609 — MATHEMATICAL METHODS FOR SYSTEMS BIOLOGY

3 credits.

Intended to provide a rigorous foundation for mathematical modeling of biological systems. Mathematical techniques include dynamical systems and differential equations. Applications to biological pathways, including understanding of bistability within chemical reaction systems, are emphasized.

**Requisites:** MATH 340 or 341; MATH 415, or cons inst

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

MATH 619 — ANALYSIS OF PARTIAL DIFFERENTIAL EQUATIONS

3 credits.

This course is a rigorous introduction to the theoretical underpinnings of the basic methods and techniques in the modern theory of PDEs. It is aimed at math majors, but will also be useful to some students in the sciences, engineering and economics who feel the need for a deeper understanding of the theory of PDEs. The emphasis is on the exposure to a number of different methods of solution of PDEs and their connection to physical phenomena modeled by the equations. The goals include both learning to solve some basic types of PDEs as well as to understand the motivation behind and inner workings of the techniques involved.

**Requisites:** a) MATH 421 or MATH 521 (b) A course covering basic theory of differential equations, such as one of MATH 319, 320, 322, 376, 519, or consent of instructor

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

MATH 621 — ANALYSIS III

3 credits.


**Requisites:** MATH 522 or cons inst

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

MATH 623 — COMPLEX ANALYSIS

3 credits.

Elementary functions of a complex variable; conformal mapping; complex integrals; the calculus of residues.

**Requisites:** MATH 321 or 521

**Course Designation:** Breadth - Natural Science

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

MATH 627 — INTRODUCTION TO FOURIER ANALYSIS

3 credits.

Fourier series and integrals, and their applications.

**Requisites:** MATH 521

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

MATH 629 — INTRODUCTION TO MEASURE AND INTEGRATION

3 credits.

Lebesgue integral and measure, abstract measure and integration, differentiation, spaces of integrable functions.

**Requisites:** MATH 522

**Course Designation:** Breadth - Natural Science

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

MATH/ I SY E/OTM/STAT 632 — INTRODUCTION TO STOCHASTIC PROCESSES

3 credits.

Topics include discrete-time Markov chains, Poisson point processes, continuous-time Markov chains, and renewal processes. Applications to queueing, branching, and other models in science, engineering and business.

**Requisites:** MATH 531 or (MATH/STAT/MATH 431, MATH/STAT/MATH 309 or STAT 311) and (MATH 320, 340, 341, 375, or 421) or graduate standing

**Course Designation:** Breadth - Natural Science

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

MATH/ I SY E/OTM 633 — QUEUING THEORY AND STOCHASTIC MODELING

3 credits.


**Requisites:** Math, Ind Engr 632 or cons inst

**Course Designation:** Breadth - Natural Science

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

Last Taught: Fall 2017
MATH 635 — AN INTRODUCTION TO BROWNIAN MOTION AND STOCHASTIC CALCULUS
3 credits.

This course presents an introduction to Brownian motion and its application to stochastic calculus. Sample path properties of Brownian motion, Ito stochastic integrals, Ito’s formula, stochastic differential equations and properties of their solutions, and various applications will be included.

Requisites: MATH 521 632
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH/ECE 641 — INTRODUCTION TO ERROR-CORRECTING CODES
3 credits.

A first course in coding theory. Codes (linear, Hamming, Golay, dual); decoding-encoding; Shannon’s theorem; sphere-packing; singleton and Gilbert-Varshamov bounds; weight enumerators; MacWilliams identities; finite fields; other codes (Reed-Muller, cyclic, BCH, Reed-Solomon) and error-correction algorithms.

Requisites: MATH 320 or 340, and MATH 541 or cons inst
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

MATH 681 — SENIOR HONORS THESIS
3 credits.

Requisites: Senior standing enrollment in the honors program
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Honors - Honors Only Courses (H)
Repeatable for Credit: No

MATH 682 — SENIOR HONORS THESIS
3 credits.

Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Honors - Honors Only Courses (H)
Repeatable for Credit: No

MATH 691 — UNDERGRADUATE THESIS
2-4 credits.

Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 692 — UNDERGRADUATE THESIS
2-4 credits.

Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

MATH 698 — DIRECTED STUDY
1-3 credits.

Graded on a Cr/N basis; consent of instructor
Requisites: Junior or Senior standing.
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 699 — DIRECTED STUDY
1-6 credits.

Graded on a lettered basis; requires cons inst
Requisites: Jr or Sr st.
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 703 — METHODS OF APPLIED MATHEMATICS 1
3 credits.

Study of the linear algebraic structure underlying discrete equilibrium problems. Boundary value problems for continuous equilibria: Sturm-Liouville equations, Laplace’s equation, Poisson’s equation, and the equations for Stokes flow. Contour integration and conformal mapping. Applications of dynamics leading to initial value problems for ODEs and PDEs. Green’s functions for ODEs and introduction to asymptotic methods for ODEs, e.g. WKB analysis. Separation of variables and eigenfunction expansions for linear PDEs. Examples from physics and engineering throughout. Not open to stdts with cr for Math 701/702

Requisites: MATH 340, 521-22, and 623 (or 623 concur), or equiv.
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

MATH 704 — METHODS OF APPLIED MATHEMATICS-2
3 credits.


Requisites: MATH 340, 521-22, and 623 (or 623 concur), or equiv.
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
MATH 705 — MATHEMATICAL FLUID DYNAMICS
3 credits.


**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2017

MATH 707 — THEORY OF ELASTICITY
3 credits.

**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2011

MATH/STAT 709 — MATHEMATICAL STATISTICS
4 credits.

Introduction to measure theoretic probability; derivation and transformation of probability distributions; generating functions and characteristic functions; conditional expectation, sufficiency, and unbiased estimation; methods of large sample theory including laws of large numbers and central limit theorems; order statistics.

**Requisites:** Cons inst or one yr adv calculus and Math, STAT/MATH 431, Math, STAT/MATH 310
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2017

MATH/STAT 710 — MATHEMATICAL STATISTICS
4 credits.

Estimation, efficiency, Neyman-Pearson theory of hypothesis testing, confidence regions, decision theory, analysis of variance, and distribution of quadratic forms.

**Requisites:** Stat, MATH/STAT 709
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No

MATH/COMP SCI 714 — METHODS OF COMPUTATIONAL MATHEMATICS I
3 credits.

Development of finite difference methods for hyperbolic, parabolic and elliptic partial differential equations. Analysis of accuracy and stability of difference schemes. Direct and iterative methods for solving linear systems. Introduction to finite volume methods. Applications from science and engineering. Students are strongly encouraged to have programming skills (e.g. COMP SCI 200) and some undergraduate numerical analysis (e.g. MATH/COMP SCI 514 or COMP SCI 412), analysis and differential equations (e.g. MATH 322 and MATH 521) and linear algebra (e.g. MATH 341)

**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2017

MATH/COMP SCI 715 — METHODS OF COMPUTATIONAL MATHEMATICS II
3 credits.

Introduction to spectral methods (Fourier, Chebyshev, Fast Fourier Transform), finite element methods (Galerkin methods, energy estimates and error analysis), and mesh-free methods (Monte-Carlo, smoothed-particle hydrodynamics) for solving partial differential equations. Applications from science and engineering. Students are strongly encouraged to have programming skills (e.g. COMP SCI 200), undergraduate numerical analysis (e.g. MATH/COMP SCI 514 or COMP SCI 412), analysis (MATH 322 and math 521) and linear algebra (e.g. MATH 341 or equiv.)

**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No

MATH 716 — ORDINARY DIFFERENTIAL EQUATIONS
3 credits.


**Requisites:** Senior (600) level analysis crse or cons inst
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** Yes, unlimited number of completions
**Last Taught:** Fall 2012

MATH 721 — A FIRST COURSE IN REAL ANALYSIS
3 credits.

A first course in real analysis concentrating on measures, integration, and differentiation and including an introduction to Hilbert spaces.

**Requisites:** MATH 522
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2017
MATH 722 — COMPLEX ANALYSIS
3 credits.

The basic theory of functions of one complex variable including Cauchy formula, singularities and residues, meromorphic functions, conformal mappings, harmonic functions, approximation and the nonhomogeneous d-bar equation.
Requisites: MATH 721; con reg in 701 or 721
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 725 — A SECOND COURSE IN REAL ANALYSIS
3 credits.

An introduction to further topics in real analysis: Banach spaces, Fourier transforms, elements of distribution theory, and applications.
Requisites: MATH 721
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH/COMP SCI/I SY E/STAT 726 — NONLINEAR OPTIMIZATION I
3 credits.

Theory and algorithms for nonlinear optimization, focusing on unconstrained optimization. Line-search and trust-region methods; quasi-Newton methods; conjugate-gradient and limited-memory methods for large-scale problems; derivative-free optimization; algorithms for least-squares problems and nonlinear equations; gradient projection algorithms for bound-constrained problems; and simple penalty methods for nonlinearly constrained optimization. Students are strongly encouraged to have knowledge of linear algebra (e.g., MATH 320, MATH 433) and familiarity with basic mathematical analysis.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 727 — CALCULUS OF VARIATIONS AND RELATED TOPICS
3 credits.

Introduction to some classical methods in the calculus of variations and continues on to modern direct methods. Techniques for establishing and studying minima and other critical points will be developed. Applications will be chosen from a wide variety of fields: geometry, differential equations, classical mechanics, geodesics, and optimal control theory. Background material in the areas of application will be provided.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2009

MATH/COMP SCI/I SY E 728 — INTEGER OPTIMIZATION
3 credits.

Introduces optimization problems over integers, and surveys the theory behind the algorithms used in state-of-the-art methods for solving such problems. Special attention is given to the polyhedral formulations of these problems, and to their algebraic and geometric properties. Applicability of Integer Optimization is highlighted with applications in combinatorial optimization. Key topics include: formulations, relaxations, polyhedral theory, cutting planes, decomposition, enumeration. Students are strongly encouraged to have knowledge of Linear Programming (e.g., COMP SCI/I SY E/MATH/COMP SCI/I SY E/STAT 525), including algorithms, duality and polyhedral theory.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH/COMP SCI/I SY E 730 — NONLINEAR OPTIMIZATION II
3 credits.

Requisites: COMP SCI/I SY E/MATH/STAT/COMP SCI/I SY E/MATH 726
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

MATH/STAT 733 — THEORY OF PROBABILITY I
3 credits.

An introduction to measure theoretic probability and stochastic processes. Topics include foundations, independence, zero-one laws, laws of large numbers, convergence in distribution, characteristic functions, central limit theorems, random walks, conditional expectations.
Requisites: MATH 629, 721, or concurrent registration in 721, or consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

MATH/STAT 734 — THEORY OF PROBABILITY II
3 credits.

Continuation of 831. Possible topics include martingales, weak convergence of measures, introduction to Brownian motion.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
MATH 735 — STOCHASTIC ANALYSIS
3 credits.
Foundations of continuous time stochastic processes, semimartingales and the semimartingale integral, Ito's formula, stochastic differential equations, stochastic equations for Markov processes, application in finance, filtering, and control.
Requisites: MATH/STAT 431 cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

MATH 740 — ENUMERATIVE COMBINATORICS/SYMMETRIC FUNCTIONS
3 credits.
Introductory graduate course on algebraic combinatorics. Topics: inclusion-exclusion principle, permutation statistics, sieve methods, unimodal sequences, posets, lattice theory, Mobius functions, generating functions, bases and transition matrices for symmetric functions, Young tableaux, plane partitions, polytopes, poset homology, Stanley-Reisner rings.
Requisites: MATH 541 542 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

MATH 741 — ABSTRACT ALGEBRA
3 credits.
The basic prerequisite for all advanced graduate courses in algebra. Usually a study of finite groups and noncommutative rings. Group theoretic topics may include: permutation groups, Lagrange’s theorem, Cauchy’s theorem and the Sylow theorems, solvable and nilpotent groups. Ring theoretic topics may include: Artinian rings and modules, the Wedderburn theorems, the Hopkins-Levitzki theorem, the Jacobson radical and density theorem.
Requisites: MATH 542 or equiv
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

MATH 742 — ABSTRACT ALGEBRA
3 credits.
Continuation of 741. Usually the study of commutative rings and fields. Ring theoretic topics may include: modules over PIDs, Noetherian rings and the Hilbert basis theorem, the Lasker-Noether theorem, the Krull intersection theorem, integrality and the Hilbert Nullstellensatz. Field theoretic topics may include: algebraic extensions, Galois theory, solvability of polynomials and classical constructability problems.
Requisites: MATH 741
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 745 — THEORY OF GROUPS
3 credits.
Usually covers a selection of topics in finite group theory including: subnormality, coprime actions, the Schur-Zassenhaus theorem, solvable and nilpotent groups, transfer theory and its applications, and normal p-complement theorems. Occasionally, the focus may be on some aspects of infinite group theory.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2012

MATH 746 — TOPICS IN RING THEORY
3 credits.
Will alternate between commutative and noncommutative ring theory. Commutative topics include localization; local rings; dimension theory; Cohen-Macaulay rings. Noncommutative topics include projective modules; injective modules; flat modules; homological and global dimension; Wedderburn and Goldie rings.
Requisites: MATH 741, 742 or equiv
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2016

MATH 747 — LIE ALGEBRAS
3 credits.
Lie algebras and matrix groups. Topics: tangent spaces; exponentials; Baker-Campbell-Hausdorff formula; (nilpotent, solvable, semisimple) Lie algebras; Engel's and Lie's theorems; Levi decomposition; Killing form; sl(2)-representations; root systems; Dynkin diagrams; Weyl groups; Cartan and Borel subalgebras; Serre’s theorem.
Requisites: MATH 541 542 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 748 — ALGEBRAIC NUMBER THEORY
3 credits.
An introductory graduate level course on algebraic number theory. Topics: a rigorous introduction to the arithmetic of number fields; algebraic integers, geometry of numbers, Dirichlet’s Unit Theorem, ideal class groups, first case of Fermat's Last Theorem; prime decompositions, Galois automorphisms.
Requisites: MATH 741-742 or equiv or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016
MATH 749 — ANALYTIC NUMBER THEORY  
3 credits.  
An introduction to (abelian) Hecke L-functions and their arithmetic applications to topics such as the distribution of primes and the study of ideal class groups.  
**Requisites:** MATH 741-742 or equiv or cons inst  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No  
**Last Taught:** Fall 2017

MATH 750 — HOMOLOGICAL ALGEBRA  
3 credits.  
A first course in homological algebra. Topics include: complexes, cohomology, double complexes, spectral sequences; abelian categories, derived categories, derived functors; Tor and Ext, Koszul complexes; group cohomology; sheaf cohomology, hypercohomology. May be taken concurrently with MATH 742  
**Requisites:** MATH 741-742 or equiv or cons inst.  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No

MATH 751 — INTRODUCTORY TOPOLOGY I  
3 credits.  
An introduction to algebraic and differential topology. Elements of homotopy theory, fundamental group, covering spaces. Differentiable manifolds, tangent vectors, regular values, transversality, examples of compact Lie groups. Homological algebra, chain complexes, cell complexes, singular and cellular homology, calculations for surfaces, spheres, projective spaces, etc.  
**Requisites:** MATH 541 and 551 or equiv  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No  
**Last Taught:** Fall 2017

MATH 752 — INTRODUCTORY TOPOLOGY II  
3 credits.  
**Requisites:** MATH 751 or equiv  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No

MATH 753 — ALGEBRAIC TOPOLOGY I  
3 credits.  
Higher homotopy groups, elements of obstruction theory, fibrations, bundle theory, classifying spaces, applications to smooth manifolds, differential forms, vector bundles, characteristic classes, cobordism, applications and calculations.  
**Requisites:** MATH 752 or equiv  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No

MATH 754 — ALGEBRAIC TOPOLOGY II  
3 credits.  
Continuation of 753. Topics include: spectral sequences and their applications, topology of Lie Groups, H-spaces, Hopf Algebras, homotopy classification of bundles, the Steenrod Algebra and its applications, introduction to generalized cohomology theories, spectra, elements of K-theory.  
**Requisites:** MATH 753 or equiv  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No

MATH 761 — DIFFERENTIABLE MANIFOLDS  
3 credits.  
Differentiable manifolds, vector bundles, implicit function theorem, submersions and immersions, vector fields and flows, foliations and Frobenius theorem, differential forms and exterior calculus, integration and Stoke’s theorem, De Rham theory, Riemannian metrics.  
**Requisites:** MATH 522 or equiv  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** Yes, unlimited number of completions  
**Last Taught:** Fall 2017

MATH 762 — DIFFERENTIAL TOPOLOGY  
3 credits.  
This course introduces the fundamental techniques and theorems of differential topology. The following topics will be covered: Submersions and immersions, Jet bundles, approximation, Sard’s theorem, Whitney embedding theorem, transversality, intersection theory, Poincare-Hopf theorem, isotopy, Hopf-degree theorem, Corbodism, Morse theory, classification of two-manifolds.  
**Requisites:** MATH 761  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** Yes, unlimited number of completions

MATH 763 — INTRODUCTION TO ALGEBRAIC GEOMETRY  
3 credits.  
Algebraic preliminaries, including local rings; valuation theory, and power series rings; geometry of algebraic varieties with emphasis on curves and surfaces.  
**Requisites:** MATH 741-742  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No  
**Last Taught:** Fall 2017
MATH 764 — INTRODUCTION TO ALGEBRAIC GEOMETRY
3 credits.
Continuation of MATH 763.
Requisites: MATH 763
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2017

MATH 765 — DIFFERENTIAL GEOMETRY
3 credits.
This course covers the metric properties of Riemannian manifolds. The following topics will be covered: Vector bundles and connections, Riemannian metrics, submanifolds and second fundamental form, first variation of arc length, geodesics, Hopf-Rinow theorem, second variation of arc length, Jacobi fields and index lemmas, Bonnet-Meyer theorem, Rauch comparison theorem, spaces of constant curvature, Hodge-de Rham theory.
Requisites: MATH 761
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 770 — FOUNDATIONS OF MATHEMATICS
3 credits.
First-order logic syntax and semantics, Completeness and Compactness Theorems, Lowenheim-Skolem Theorem, computable and computably enumerable sets, Incompleteness Theorem, axioms of Zermelo-Fraenkel set theory with choice, ordinal and cardinal arithmetic.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

MATH 771 — SET THEORY
3 credits.
Martin's Axiom, Suslin and Aronszajn trees, diamond principle, absoluteness and reflection, constructible universe, and one-step forcing constructions.
Requisites: MATH 770
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 773 — COMPUTABILITY THEORY
3 credits.
Turing degree and jump, strong reducibilities, arithmetic hierarchy, index sets, simple and (hyper)hypersimple sets, easy forcing arguments in computability theory, finite and infinite injury, Friedberg-Muchnik and Sacks Splitting Theorem, Sacks Jump and Sacks Density Theorems, computable ordinals.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH 776 — MODEL THEORY
3 credits.
Requisites: MATH 770
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

MATH/CBE/E C E 777 — NONLINEAR DYNAMICS, BIFURCATIONS AND CHAOS
3 credits.
Advanced interdisciplinary introduction to qualitative and geometric methods for dissipative nonlinear dynamical systems. Local bifurcations of ordinary differential equations and maps. Chaotic attractors, horseshoes and detection of chaos.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2016

MATH 790 — MASTERS THESIS
1-3 credits.
This course is intended for students who work on a Master's thesis under the supervision of a faculty member.
Requisites: Enrollment in the Foundations of Advanced Studies option of the department's Master's program, and consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, for 2 number of completions

MATH 801 — TOPICS IN APPLIED MATHEMATICS
3 credits.
Selected topics in applied mathematics, applied analysis or numerical analysis and scientific computing.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH/STAT 803 — EXPERIMENTAL DESIGN I
3 credits.
Summary of matrix algebra required, theory of estimable functions, incomplete blocks, balanced incomplete block designs, partially balanced incomplete block designs.
Requisites: Stats 310 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017
MATH 805 — SPECIAL FUNCTIONS
3 credits.
Special functions arising from mathematics, physics, and engineering, their series and integral representations, differential and other functional equations, generating functions, and orthogonality.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2010

MATH 807 — DYNAMICAL SYSTEMS
3 credits.
Treats the qualitative behavior of continuous and discrete dynamical systems, including Hamiltonian systems of differential equations. Typical topics include periodic and almost periodic solutions, the fixed point theorem of Poincare and Birkhoff, invariant curves and Kam theory, celestial mechanics, and chaotic behavior.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 812 — ADVANCED METHODS OF APPLIED MATHEMATICS
3 credits.
Differential equations; asymptotic methods in complex analysis; problems of matching; integral transforms; integral equations; introduction to spectral theory; calculus of variations; tensor analysis.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 819 — PARTIAL DIFFERENTIAL EQUATIONS
3 credits.
Classical theory of partial differential equations, together with an introduction to the modern theory based on functional analysis.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

MATH 820 — PARTIAL DIFFERENTIAL EQUATIONS
3 credits.
Continuation of MATH 819.
Requisites: MATH 819
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 821 — ADVANCED TOPICS IN REAL ANALYSIS
3 credits.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

MATH 823 — ADVANCED TOPICS IN COMPLEX ANALYSIS
3 credits.
Several complex variables. Basic several complex variables or more special topics.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

MATH 825 — SELECTED TOPICS IN FUNCTIONAL ANALYSIS
3 credits.
Topics will vary and may include spectral theory, nonlinear functional analysis or abstract harmonic analysis.
Requisites: Cons inst or MATH 722
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 826 — ADVANCED TOPICS IN FUNCTIONAL ANALYSIS AND DIFFERENTIAL EQUATIONS
3 credits.
Continuation of MATH 825.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2016

MATH 827 — FOURIER ANALYSIS
3 credits.
Introduction to Fourier analysis in Euclidean spaces and related topics that may include singular and oscillatory integrals and trigonometric series.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

MATH 828 — ADVANCED TOPICS IN HARMONIC ANALYSIS
3 credits.
Continuation of MATH 827. Advanced topics related to research in harmonic analysis.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH/STAT 833 — TOPICS IN THE THEORY OF PROBABILITY
3 credits.
Topics in probability and stochastic processes.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017
MATH/COMP SCI 837 — TOPICS IN NUMERICAL ANALYSIS
3 credits.

Advanced topics in numerical analysis relevant to current research at UW. Each offering of the course will cover a topic selected by the instructor. Topics may include: fluid dynamics, computational methods, mathematical biology, and others.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2011

MATH/E C E 842 — TOPICS IN APPLIED ALGEBRA
3 credits.

Applied topics with emphasis on algebraic constructions and structures. Examples include: algebraic coding theory; codes (algebraic-geometric, convolutional, low-density-parity-check, space-time); curve and lattice based cryptography; watermarking; computer vision (face recognition, multiview geometry).

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

MATH 843 — REPRESENTATION THEORY
3 credits.


Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2016

MATH 844 — ARITHMETIC GEOMETRY
3 credits.

An introduction to arithmetic geometry with emphasis on arithmetic of elliptic curves.

Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

MATH 845 — CLASS FIELD THEORY
3 credits.

Introduction to local and global class field theory. Theory of local fields; local and global class field theory; complex multiplication, adeles, ideles, idele class characters, Tchebotarev’s Density Theorem, CM elliptic curves, construction of class fields of imaginary quadratic fields.

Requisites: MATH 748 or 749 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2017

MATH 846 — TOPICS IN COMBINATORICS
3 credits.

Topics in algebraic combinatorics such as (but not limited to) association schemes, hypergeometric series, classical orthogonal polynomials, codes, lattices, invariant theory, alternating sign matrices and domino tilings, statistical mechanical models, 6j-symbols, buildings and diagram geometries, matroids.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 847 — TOPICS IN ALGEBRA
3 credits.

Topics may include: Lie groups, algebraic groups, Chevalley groups, simple groups and associated geometries, group cohomology, group rings, Hopf algebras, enveloping algebras, quantum groups, infinite-dimensional Lie algebras, Hecke algebras, automorphic forms, Galois representations, zeta and L-functions, abelian varieties.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

MATH 848 — ADVANCED TOPICS IN NUMBER THEORY
3 credits.

This is an advanced graduate topic course in number theory. Topics will vary. Target audience: Advanced graduate students in number theory, representation theory, and algebraic geometry.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2016

MATH 849 — AUTOMORPHIC FORMS
3 credits.

Classical and/or modern theory of automorphic forms. Representation theory of GL(2).

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
MATH 851 — TOPICS IN GEOMETRIC TOPOLOGY
3 credits.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2017

MATH 853 — TOPICS IN ALGEBRAIC TOPOLOGY
3 credits.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2016

MATH 856 — TOPICS IN DIFFERENTIAL TOPOLOGY
3 credits.
The theory of differential manifolds such as differential forms and de Rham theorem, cobordism groups, Lie groups, homogeneous spaces, fiber bundles, characteristic classes.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

MATH 863 — ADVANCED TOPICS IN ALGEBRAIC GEOMETRY
3 credits.

Geometry of several complex variables; algebraic groups, abelian varieties; topological aspects of algebraic geometry, including sheaf theory and homology theory; advanced theory of local rings; intersection theory of algebraic varieties.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 865 — ADVANCED TOPICS IN GEOMETRY
3 credits.

Selected from advanced projective geometry, non-Euclidean geometry, Riemannian geometry, distance geometry and the geometry of convex surfaces, geometry of numbers.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 873 — ADVANCED TOPICS IN FOUNDATIONS
3 credits.

From all areas of mathematical logic.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 903 — SEMINAR IN MATHEMATICS EDUCATION
1-3 credits.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 921 — SEMINAR IN ANALYSIS
1-3 credits.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 941 — SEMINAR-ALGEBRA
1-3 credits.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 951 — SEMINAR IN TOPOLOGY
1-3 credits.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 967 — SEMINAR IN NUMBER THEORY
1-3 credits.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 975 — SEMINAR-THE FOUNDATIONS OF MATHEMATICS
1-3 credits.

From all areas of mathematical logic.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

MATH 990 — READING AND RESEARCH
1-3 credits.

Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
MATH 991 — SEMINAR IN APPLIED MATHEMATICS
1-3 credits.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions