

MATHEMATICS (M)

M 065 - Prealgebra. 3 Credits.

Offered every term. Offered at Missoula College. Arithmetic and basic algebra skills needed for Introductory Algebra. Topics include integers and rational numbers, decimals and percentages with applications, ratios and proportions with applications, single variable linear equations with applications, introduction to graphing, exponents, factoring, and an introduction to polynomials. Credit does not count toward a certificate or degree. Credit does not count toward Associate of Arts, Associate of Applied Science, or Baccalaureate degrees.

M 090 - Introductory Algebra. 3 Credits.

Offered every term. Offered at Missoula College. Prereq., M 065 or appropriate math placement score. Review of arithmetic principles of integers and rational numbers, linear equations in one or two unknowns, systems of linear equations and operations with polynomials and rational expressions. Credit does not count toward an Associate of Arts, Associate of Applied Science, or Baccalaureate degree.

M 095 - Intermediate Algebra. 3 Credits.

Offered autumn and spring. Offered at Missoula College. Prereq., M 090 or appropriate math placement score. Topics include linear equations, inequalities, applications and graphing; polynomials; radicals, rational exponents and complex numbers; quadratic equations. Graphing calculator required. Credit does not count toward Associate of Arts or Baccalaureate degrees.

M 104 - Numbers as News. 3 Credits.

Offered intermittently. Prereq. M 090 with a grade of B- or better; or M 095 with a grade of C- or better; or EdReady placement level 2; or M01-Maplesoft Arithmetic score ≥ 16 ; or ACT score of 22; or SAT score of 520. An exploration of mathematics and statistics as used in the popular media. For students in the School of Journalism only.
Gen Ed Attributes: Math Competency

M 105 - Contemporary Mathematics. 3-4 Credits.

Offered every term. Prereq., M 090 or M 095 with a grade of C- or better; or EdReady placement level 2; or M01-Maplesoft Arithmetic score ≥ 16 ; or ACT score of 21; or SAT score of 530 (with the new test); or ACT score of 20 and HS GPA 3.2; or SAT score of 510 and HS GPA 3.2. An introduction to mathematical ideas and their impact on society. Intended for students wishing to satisfy the general education mathematics requirement. Co-Requisite Support sections of M 105 are 4 credits; they are offered autumn and spring and require consent of instructor. Co-requisite support section prerequisites as follows: EdReady placement level 1 or consent of instructor.
Gen Ed Attributes: Math Competency

M 111 - Technical Mathematics. 3 Credits.

Offered autumn and spring. Offered at Missoula College. Designed to provide the mathematical background necessary for success in the industrial areas. Topics covered include percent, ratio proportion, formula evaluation, basic algebra and geometry concepts, trigonometry, measurement, statistics, and graphing. Markdowns, inventory turnover, and other basic formulas. Credit does not count toward Associate of Arts or Baccalaureate degrees.

M 115 - Probability and Linear Mathematics. 4 Credits.

Offered every term. Prereq., M 090 or M 095 with a grade of C- or better; or EdReady placement level 2; or M01-Maplesoft Arithmetic score ≥ 16 ; or ACT score of 21; or SAT score of 530 (with the new test); or ACT score of 20 and HS GPA 3.2; or SAT score of 510 and HS GPA 3.2. Systems of linear equations and matrix algebra. Introduction to probability with emphasis on models and probabilistic reasoning. Examples of applications of the material in many fields. Co-Requisite Support sections of M 115 are 4 credits; they are offered autumn and spring. Co-requisite support section prerequisites as follows: EdReady placement level 1.5; or ACT score of 18; or SAT score of 460 (with the new test); or ACT score of 15 and HS GPA 3.0; or SAT score of 400 and HS GPA 3.0; or consent of instructor.

Gen Ed Attributes: Math Competency

M 118 - Mathematics for Music Enthusiasts. 3 Credits.

Offered autumn and/or spring. Prereq. M 090 with a grade of B- or better; or M 095 with a grade of C- or better; or EdReady placement level 2; or M01-Maplesoft Arithmetic score ≥ 18 ; or ACT score of 21; or SAT score of 530 (with the new test); or ACT score of 20 and HS GPA 3.2; or SAT score of 510 and HS GPA 3.2; and elementary music background. An introduction to the interplay between mathematics and music. Course intended for Music majors/minors, and others with musical backgrounds/interests, who wish to satisfy the general education mathematics requirement.

Gen Ed Attributes: Math Competency

M 121 - College Algebra. 3,4 Credits.

Offered every term. Prereq., M 095; or EdReady placement level 3; or M02-Maplesoft Algebra score ≥ 14 ; or ACT score of 23; or SAT score of 560 (with the new test); or ACT score of 21 and HS GPA 3.4; or SAT score of 530 and HS GPA 3.4. The central theme of College Algebra is functions as models of change. This course fulfills the prerequisites for M 122 (College Trigonometry) and for M 162 (Applied Calculus). Intended to strengthen algebra skills. The study of functions and their inverses; polynomial, rational, exponential, and logarithmic functions. Credit not allowed for both M 121 and M 151. Co-Requisite Support sections of M 121 are 4 credits; they are offered autumn and spring. Co-requisite support section prerequisites as follows: EdReady placement level 2.5; M01-Maplesoft Arithmetic score ≥ 16 ; or M02-Maplesoft Algebra score ≥ 10 ; or ACT score of 22; or SAT score of 540 (with the new test); or ACT score of 21 and HS GPA 3.4; or SAT score of 530 and HS GPA 3.4; if the student is fresh out of high school, completion of Algebra II or beyond; or consent of instructor.

Gen Ed Attributes: Math Competency

M 122 - College Trigonometry. 3 Credits.

Offered autumn and spring. Prereq., M 121 or ALEKS placement ≥ 4 . Preparation for calculus based on college algebra. Review of functions and their inverses. Trigonometric functions and identities, polar coordinates and an optional topic such as complex numbers, vectors or parametric equations. Credit not allowed for both M 122 and M 151.

Gen Ed Attributes: Math Competency

M 132 - Numbers and Operations for Elementary School Teachers. 3 Credits.

Offered autumn and spring. Prereq., M 095; or M 115; or EdReady placement level 3; or M02-Maplesoft Algebra score ≥ 14 ; or ACT score of 23; or SAT score of 560 (with the new test); or ACT score of 21 and HS GPA 3.5; or SAT score of 530 and HS GPA 3.5. The study of number and operations for prospective elementary and middle school teachers, including whole numbers, decimals, fractions, percent, integers, operations, numeration systems, and problem solving.

Gen Ed Attributes: Math Competency

M 133 - Geometry and Measurement for Elementary School Teachers. 3 Credits.

Offered autumn and spring. Prereq., M 132. The study of geometry and geometric measurement for prospective elementary and middle school teachers, including synthetic, transformational, and coordinate geometry, constructions, congruence and similarity, 2-dimensional and 3-dimensional measurement, and problem solving.

Gen Ed Attributes: Math Competency

M 151 - Precalculus. 4 Credits.

Offered autumn and spring. Prereq., EdReady placement level 4; or M02-Maplesoft Algebra score ≥ 17 ; or M03-Maplesoft Calculus score ≥ 10 ; or ACT score of 25; or SAT score of 590 (with the new test); or ACT score of 23 and HS GPA 3.6 and HS Precalc or Calculus with a B- or better; or SAT score of 560 and HS GPA 3.5 and HS Precalc or Calculus with a B- or better. A one semester preparation for calculus (as an alternative to M 121 - M 122. Functions of one real variable are introduced in general and then applied to the usual elementary functions, namely polynomial and rational functions, exponential and logarithmic functions, trigonometric functions, and miscellaneous others. Inverse functions, polar coordinates and trigonometric identities are included. Credit not allowed for both M 151 and M 121 or M 122.

Gen Ed Attributes: Math Competency

M 162 - Applied Calculus. 4 Credits.

Offered autumn and spring. Prereq., EdReady placement level 4; or M02-Maplesoft Algebra score ≥ 19 ; or M03-Maplesoft Calculus score ≥ 10 ; or one of M 121, M 122 or M 151; or ACT score of 25; or SAT score of 590 (with the new test); or ACT score of 23 and HS GPA 3.6 and HS Precalc or Calculus with a B- or better; or SAT score of 560 and HS GPA 3.6 and HS Precalculus or Calculus with a B- or better. Introductory course surveying the principal ideas of differential and integral calculus with emphasis on applications and computer software. Mathematical modeling in discrete and continuous settings. Intended primarily for students who do not plan to take higher calculus.

Gen Ed Attributes: Math Competency

M 171 - Calculus I. 4 Credits.

Offered autumn and spring. Prereq., M 122; or M 151; or Maplesoft Calculus score ≥ 15 ; or UM WeBWorK Calculus Placement score ≥ 11 . Differential calculus, including limits, continuous functions, Intermediate Value Theorem, tangents, linear approximation, inverse functions, implicit differentiation, extreme values and the Mean Value Theorem. Integral Calculus including antiderivatives, definite integrals, and the Fundamental Theorem of Calculus.

Gen Ed Attributes: Math Competency

M 172 - Calculus II. 4 Credits.

Offered autumn and spring. Prereq., M 171 or M 181. Techniques of Integration. Area computations. Improper integrals. Infinite series and various convergence tests. Power series. Taylor's Formula. Polar coordinates. Parametric curves.

Gen Ed Attributes: Math Competency

M 181 - Honors Calculus I. 4 Credits.

Offered intermittently in autumn. Prereq., M 122 or M 151 or ALEKS placement ≥ 5 or M03-Maplesoft Calculus score ≥ 15 . Honors version of M 171.

Gen Ed Attributes: Math Competency

M 182 - Honors Calculus II. 4 Credits.

Offered spring. Prereq., M 181 or consent of instr. Honors version of M 172.

Gen Ed Attributes: Math Competency

M 191 - Special Topics. 1-6 Credits.

(R-6) Offered autumn and spring. Prereq., consent of instr. Experimental offerings of visiting professors, experimental offerings of new courses, or one time offerings of current topics.

M 192 - Independent Study. 1-6 Credits.

(R-6) Offered intermittently. Course material appropriate to the needs and objectives of the individual student.

M 210 - Introduction to Mathematical Software. 3 Credits.

Offered spring. Prereq., one of M 162, M 171, or M 181, or consent of instr. Software packages useful for doing and writing mathematics. Introduction to a computer algebra system (such as Maple or Mathematica), a numerical package (such as MATLAB or R), and elementary programming. Writing and communicating mathematics using the mathematical typesetting system LaTeX.

M 221 - Introduction to Linear Algebra. 4 Credits.

Offered autumn and spring. Prereq., M 172 or M 182. Vectors in the plane and space, systems of linear equations and Gauss-Jordan elimination, matrices, determinants, eigenvalues and eigenvectors, vector spaces, linear transformations. Calculators and/or computers used where appropriate.

M 225 - Introduction to Discrete Mathematics. 3 Credits.

Offered autumn. Prereq., one of M 162, M 171, or M 181 or consent of instr. Mathematical concepts used in computer science with an emphasis on mathematical reasoning and proof techniques. Elementary logic, sets, functions and relations, combinatorics, mathematical induction, recursion and algorithms. Mathematics majors should take M 307 instead of M 225.

M 234 - Higher Mathematics for Elementary School Teachers. 3 Credits.

Offered autumn and spring. Prereq., M 132. The study of algebra, number theory, probability and statistics for prospective elementary and middle school teachers, including proportional reasoning, functions, elementary number theory, statistical modeling and inference, and elementary probability theory.

M 263 - Applied Differential Equations. 3 Credits.

Offered intermittently. Prereq., one of M 162, M 171 or M 181 and knowledge of basic trigonometry. Solution of ordinary differential equations and systems with emphasis on applications, numerical methods and computer software.

M 273 - Multivariable Calculus. 4 Credits.

Offered autumn and spring. Prereq., M 172 or M 182. Calculus of functions of several variables; differentiation and elementary integration. Vectors in the plane and space.

M 274 - Introduction to Differential Equations. 3 Credits.

Offered autumn. Prereq., M 273. Ordinary differential equations. Systems of linear differential equations from a matrix viewpoint. Series solutions. Existence and uniqueness for initial value problems. Numerical methods. Stability and selected topics. M 275 computer lab recommended.

M 275 - Differential Equations Computer Lab. 1 Credit.

Offered autumn. Coreq., M 274 or consent of instr. Intended primarily for student in M 274.

M 291 - Special Topics. 1-3 Credits.

(R-9) Offered autumn and spring. Prereq., consent of instr. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

M 292 - Independent Study. 1-9 Credits.

(R-9) Offered autumn and spring. Prereq., consent of instr. Guidance of an individual student in doing independent study on material not offered in a regular course.

M 294 - Seminar. 1-9 Credits.

(R-9) Offered intermittently. Prereq., consent of instr.

M 295 - Practicum. 1-6 Credits.**M 300 - Undergraduate Mathematics Seminar. 1 Credit.**

(R-3) Offered every semester. Prereq., M 171 or M 181. Discussion seminar focused on topics and issues of interest to students in the mathematical sciences. Course graded only on CR/NCR basis.

M 301 - Teaching Mathematics with Technology. 3 Credits.

Offered autumn, odd-numbered years. Prereq., M 162 or M 171 or consent of instructor. Discrete and continuous mathematical models from a variety of disciplines using appropriate technology.

M 307 - Introduction to Abstract Mathematics. 3 Credits.

Offered autumn and spring. Prereq., M 172 or M 182. Designed to prepare students for upper-division proof-based mathematics courses. Topics include proof techniques, logic, sets, relations, functions and axiomatic methods. Students planning to take both M 221 and M 307 are encouraged to take M 221 first.

M 325 - Discrete Mathematics. 3 Credits.

Offered intermittently. Prereq., M 171 and M 225 or M 307. Continuation of M 225 and topics from graph theory, Boolean algebras, automata theory, coding theory, computability and formal languages.

M 326 - Number Theory. 3 Credits.

Offered spring. Prereq., M 225 or M 307. Congruences, Diophantine equations, properties of primes, quadratic residues, continued fractions, algebraic numbers.

M 361 - Discrete Optimization. 3 Credits.

Offered spring. Prereq., one of M 162, M 172 or M 182 (M 221 or M 225 recommended). Intended for non-mathematics majors as well as mathematics majors. Introduction to discrete optimization and modeling techniques with applications. Topics from combinatorics and graph theory, including enumeration, graph algorithms, matching problems and networks.

M 362 - Linear Optimization. 3 Credits.

Offered autumn. Prereq., one of M 162, M 172 or M 182 (M 221 recommended). Coreq., M 363 recommended. Intended for non-mathematics majors as well as majors. Introduction to linear programming and modeling techniques with applications. Topics include the simplex method, duality, sensitivity analysis and network models.

M 363 - Linear Optimization Laboratory. 1 Credit.

Offered autumn. Coreq., M 362. Introduction to linear optimization software.

M 381 - Advanced Calculus I. 3 Credits.

Offered autumn even-numbered years. Prereq., M 307. Rigorous development of single-variable calculus with formal proof. Functions, sequences, limits, continuity, differentiation, and integration.

M 391 - Special Topics. 1-9 Credits.

(R-9) Offered autumn and spring. Prereq., consent of instr. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

M 392 - Independent Study. 1-9 Credits.

(R-9) Offered autumn and spring. Prereq., consent of instr. Guidance of an individual student in doing independent study on material not offered in a regular course.

M 394 - Seminar. 1-9 Credits.

(R-9) Offered autumn and spring. Prereq., consent of instr.

M 398 - Internship. 1-6 Credits.

Offered autumn and spring. Prereq., consent of instructor. Extended classroom experience which provides practical application of classroom learning during placements off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation.

M 412 - Partial Differential Equations. 3 Credits.

Offered spring. Prereq., M 274. Fourier series, Sturm-Liouville and boundary value problems. Partial differential equations: Cauchy problems and the method of characteristics, separation of variables and Laplace transform methods. Numerical methods and selected topics. M 418 computer lab recommended. Level: Undergraduate-Graduate

M 414 - Deterministic Models. 3 Credits.

Offered spring. Prereq., M 263 or M 274 or consent of instr. Linear and nonlinear difference and differential equations: stability, phase-plane analysis, oscillatory behavior, limit cycles, and chaos. Eigenvalues and eigenfunctions. Emphasis on models in biology. Level: Undergraduate-Graduate

M 429 - History of Mathematics. 3 Credits.

Offered spring. Prereq., WRIT 101 or equivalent, one intermediate writing course and M 307. Historical study of the development of mathematics from the Egyptian and Babylonian eras to the 20th century. Level: Undergraduate-Graduate
Gen Ed Attributes: Advanced Writing

M 431 - Abstract Algebra I. 4 Credits.

Offered autumn. Prereq., M 221 and M 307 or consent of instr. An introduction to modern ideas of algebra through the study of groups, rings, and fields. Level: Undergraduate-Graduate

M 432 - Abstract Algebra II. 4 Credits.

Offered intermittently in spring. Prereq., M 431. Continues the investigation of groups, rings, and fields begun in M 431. Further topics include vector spaces and field extensions. Level: Undergraduate-Graduate

M 439 - Euclidean and NonEuclidean Geometry. 3 Credits.

Offered autumn. Prereq., M 307. Euclidean geometry from a rigorous, axiomatic viewpoint and Non-Euclidean geometries chosen from Lobachevskian, projective, finite and Riemannian. Level: Undergraduate-Graduate

M 440 - Numerical Analysis. 3 Credits.

Offered in Autumn. Prereq., M 221, M 274, and some experience with computer programming. Topics include: error analysis; approximation and interpolation; numerical solution of linear and non-linear equations; numerical optimization; numerical integration of ordinary and partial differential equations; and applications. Level: Undergraduate

M 445 - Statistical, Dynamical, and Computational Modeling. 4 Credits.

Offered autumn odd-numbered years. Prereq., consent of instr. An interdisciplinary course on the integration of statistical and dynamical models with applications to biological problems. Linear and nonlinear models, estimation, systems of ordinary differential equations, numerical integration, bootstrapping, MCMC methods. Intended both for students in mathematics and the natural sciences. Level: Undergraduate-Graduate

M 461 - Data Science Analytics. 3 Credits.

Offered autumn. Prereq., STAT 341, and one of M 221 or M 273, or consent of instructor. This is a methods course supporting the Big Data Certificate Program. The course provides the students with the essential tools of data analytics. The content consists of data dictionaries and data mappings, distributed computing, and related methods. Other topics may include data visualization, regression, and cluster analysis. This course may be used to satisfy the course requirements of the Big Data Certificate Program. Level: Undergraduate. Co-convenes with M 561.

M 462 - Theoretical Basics of Big Data Analytics and Real Time Computation Algorithms. 3 Credits.

Offered spring. Prereq., M 221 and two other Mathematics / Statistics classes at the 200-level or above, or consent of instr. The main goal of this course is to provide students with a unique opportunity to acquire conceptual knowledge and theoretical background behind mathematical tools applicable to Big Data Analytics and Real Time Computations. Specific challenges of Big Data Analytics, e.g., problems of extracting, unifying, updating, and merging information, and processing of highly parallel and distributed data, will be reviewed. The tools for Big Data Analytics, such as regression analysis, linear estimation, calibration problems, real time processing of incoming (potentially infinite) data, will be studied in more detail. It will be shown how these approaches can be transformed to conform to the Big Data demands. Level: Undergraduate

M 467 - Data Science Projects. 3 Credits.

Offered spring. Prereq., two courses chosen from STAT 341, M 221 and M 273, and one of M 461 or M 462, or consent of instructor. This course is a practicum course aimed at developing skills needed to solve data science problems facing industry and academics. Problems are brought to the class by local technology-oriented businesses and university researchers. Lecture topics include project management, interacting with clients, and written and oral presentation of results. Additional lecture topics will be selected to address the specific problems brought to the class and may cover data reduction methods, algorithm design and predictive analytics. Level: Undergraduate. Co-convenes with M 567.

M 472 - Introduction to Complex Analysis. 4 Credits.

Offered spring. Prereq., M 273, M 307. Analytic functions, complex integration, singularities and application to contour integration, harmonic functions, spaces of analytic functions. Level: Undergraduate-Graduate

M 473 - Introduction to Real Analysis. 4 Credits.

Offered autumn odd-numbered years. Prereq., M 273 and M 307. Theory of metric spaces and point set topology, Riemann-Stieltjes integral, sequences and series of functions. Stone-Weierstrass theorem, theorem of Arzela-Ascoli, introduction to Lebesgue integration. Level: Undergraduate-Graduate

M 485 - Graph Theory. 3 Credits.

Offered autumn. Prereq., M 307 or M 361, or consent of instr. Theory and applications of graphs. Topics chosen from trees, matchings, connectivity, coloring, planarity, Ramsey theory, random graphs, combinatorial designs and matroid theory. Level: Undergraduate-Graduate

M 490 - Undergraduate Research. 1-4 Credits.

(R-12) Offered every term. Prereq., consent of instr. Undergraduate research in the mathematical sciences under the direction of a faculty member. Graded credit/no credit. Level: Undergraduate

M 491 - Special Topics. 1-9 Credits.

(R-9) Offered autumn and spring. Prereq., consent of instr. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics. Level: Undergraduate-Graduate

M 492 - Independent Study. 1-9 Credits.

(R-9) Offered autumn and spring. Prereq., consent of instr. Guidance of an individual student in doing independent study on material not offered in a regular course. Level: Undergraduate

M 494 - Seminar. 1-9 Credits.

(R-9) Offered autumn and spring. Prereq., consent of instr. Level: Undergraduate

M 498 - Internship. 1-6 Credits.

Offered autumn and spring. Prereq., consent of instr. Extended classroom experience which provides practical application of classroom learning during placements off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation. Level: Undergraduate

M 499 - Senior Thesis. 1-12 Credits.

(R-12) Offered autumn and spring. Prereq., WRIT 101 or equivalent, and one intermediate writing course and consent of instr. Senior thesis for mathematics majors and/or Watkins Scholars. Level: Undergraduate
Gen Ed Attributes: Advanced Writing

M 500 - Current Mathematical Curricula. 3 Credits.

Offered intermittently. Prereq., teacher certification and Math graduate majors only or consent of instructor. Analysis of contemporary materials for secondary school mathematics: the goals, the mathematical content, alternative methodologies, and curriculum evaluation. Level: Graduate

M 501 - Technology in Mathematics for Teachers. 3 Credits.

Offered intermittently. Prereq., teacher certification or consent of instructor. Technology usage when it is appropriate and when it is not. Experience is provided with scientific calculators, graphing utilities, computers, and identification of exemplary software. Level: Graduate

M 504 - Topics in Mathematics Education. 1-12 Credits.

(R-12) Offered intermittently. Prereq., teacher certification. Topics of current interest which may include calculus, number theory, probability and statistics, geometry, or algebra, at a level suitable for teachers. Level: Graduate

M 510 - Problem Solving for Teachers. 3 Credits.

Offered intermittently. Prereq., teacher certification or consent of instructor. Strategies for problem solving, problem posing in a variety of situations, modeling and applications. Problems are selected from various areas of mathematics. Level: Graduate

M 511 - Advanced Mathematical Methods I. 3 Credits.

Offered autumn odd-numbered years. Prereq., M 274, and M 412 or M 414. Methods in applied mathematics related to the qualitative and quantitative solution of nonlinear and differential integral equations, dynamical systems, and perturbation methods. Applications of these methods to other sciences. Level: Graduate

M 512 - Advanced Mathematical Methods II. 3 Credits.

Offered spring even-numbered years. Prereq., M 511. Continuation of M 511. Level: Graduate

M 514 - Topics in Applied Mathematics. 1-12 Credits.

(R-12) Offered autumn even-numbered years. Prereq., consent of instr. or M 511 and M 512. Topics of current interest in applied mathematics, mathematical modeling, dynamic modeling, and optimal management in stochastic or deterministic environments. Level: Graduate

M 521 - Advanced Algebra I. 3 Credits.

Offered alternate years in autumn. Recommended prereq., M 432 or consent of instr. Topics covered include group theory, field theory and Galois theory. Level: Graduate

M 522 - Advanced Algebra II. 3 Credits.

Offered alternate years in spring. Prereq., M 521 or consent of instr. Continuation of M 521; rings, modules, commutative algebra, and further topics. Level: Graduate

M 524 - Topics in Algebra. 3 Credits.

(R-12) Offered alternate years in fall and spring. Prereq., consent of instr. Topics chosen from algebra and related areas, for example from commutative algebra, algebraic geometry, linear algebra, group theory, ring theory, or number theory. Level: Graduate

M 531 - Topology. 3 Credits.

Offered autumn even-numbered years. Prereq., M 473 or consent of instr. Set theory, topological spaces, metrizability, continuous mappings and selected topics. Level: Graduate

M 532 - Algebraic Topology. 3 Credits.

Offered spring alternate years. Prereq., M 431 and M 531 or consent of instr. Introduction to algebraic topology through one or more topics chosen from the fundamental group and higher homotopy groups, singular homology, and simplicial homology. Level: Graduate

M 540 - Numerical Methods for Computational & Data Science. 3 Credits.

Prereq., M 221, M 274, and some experience with computer programming. Topics include: error analysis; approximation and interpolation; numerical solution of linear and non-linear equations; numerical optimization; numerical integration of ordinary and partial differential equations. This course will focus specifically on techniques from numerical analysis that have applications in modern computational and data science. Students will be expected to learn the theoretical underpinnings of the methods they use, as well as to implement the methods in computer code. Level: Graduate

M 551 - Real Analysis. 3 Credits.

Offered autumn even-numbered years. Prereq., M 473 or M 472 or consent of instr. Measure theory, abstract integration theory, theory of L_p -spaces. Level: Graduate

M 555 - Functional Analysis. 3 Credits.

Offered autumn odd-numbered years. Prereq., M 473 or M 472 or consent of instr. Normed linear spaces, linear functionals, separation theorems, topological linear spaces, weak topologies, dualities. Level: Graduate

M 561 - Advanced Data Science Analytics. 3 Credits.

Offered autumn. Prereq., STAT 341 or STAT 421 and at least two upper division math courses. Topics include: data mappings and data reduction, scalable algorithms and associative statistics, Hadoop and MapReduce, data visualization, linear regression methods, healthcare analytics and cluster analysis. Level: Graduate. Co-convenes with M 461.

M 562 - Advanced Theoretical Big Data Analytics. 3 Credits.

Offered spring. Prereq., M 540 and M 561. Topics include: The notion of canonical information, linear experiment and optimal estimation problem, manipulating information in different forms: raw vs. explicit vs. canonical, Gauss-Markov theorem, calibration problem; real time signal processing with finite and infinite field of view. time series processing; balancing estimation accuracy, delay and computational demands. Image processing with infinite field of view; parallel processing of signals and images. Level: Graduate

M 564 - Topics in Analysis. 3 Credits.

(R-12) Offered spring. Prereq., consent of instr. Research projects or topics in analysis. May include but not restricted to Banach algebras, Fourier analysis, Harmonic analysis, Hilbert space theory, integral equations, or operator theory. Level: Graduate

M 567 - Advanced Big Data Analytics Projects. 3 Credits.

Offered spring. Prereq., two courses chosen from STAT 341, M 221 and M 273, and one of M 461 or M 462. In this course, local businesses and University researchers will contribute practical problems from data science to the class. Students will learn how to work in teams to develop solutions to the contributed problems, graduate students will serve as lead investigators on these teams. Learning outcomes include: Develop data reduction algorithms for complex problems and varied data. Apply mathematical, statistical, and computational methods used in solving big data problems. Extend and adapt core algorithms to specific problems. Work with a client towards understanding client objectives and meeting the objectives. Propose alternative paths towards the solution when necessary. Plan a project (determine what is realistic and achievable within a time frame). Document progress and elicit feedback from clients. Write concise and focused progress reports. Efficiently allocate workload among team members. Effectively communicate and participate as a team member. Level: Graduate. Co-convenes with M 467.

M 570 - Calculus for Teachers. 3 Credits.

Offered online in even-year summers. Prereq., teacher certification or consent of instr. Math knowledge for teaching concepts that support the learning of calculus across grades K-12. The content focus is differential and integral calculus. The pedagogical focus is teaching calculus concepts through active investigation and problem solving. Level: Graduate

M 572 - Algebra for Teachers. 3 Credits.

Offered online in even-year summers. Prereq., teacher certification or consent of instr. Math knowledge for teaching algebra across grades 5-12. The pedagogical focus is algebraic thinking and how it develops across the grades through problem solving. The content focus is algebraic number fields, functions, linear algebra, and polynomials. Level: Graduate

M 573 - Geometry For Teachers. 3 Credits.

Offered online in odd-year summers. Prereq., teacher certification or consent of instr. Math knowledge for teaching geometry across grades 5-12. The pedagogical focus is on geometric thinking and how it develops across grades 5-12 through problem solving. The content focus is synthetic, analytic, vector, and transformational approaches to geometry. Level: Graduate

M 574 - Probability and Statistics for Teachers. 3 Credits.

Offered online in odd-year summers. Prereq., teacher certification or consent of instr. Math knowledge for teaching probability and statistics across grades 5-12. The pedagogical focus is on understanding statistical thinking and its development through statistical problem solving. The content focus is developing statistical models to answer statistical questions. Level: Graduate

M 581 - Combinatorics. 3 Credits.

Offered autumn odd-numbered years. Prereq., consent of instr. Theory and applications of discrete mathematics. Topics chosen from enumeration, combinatorial analysis, and graph theory. Level: Graduate

M 582 - Optimization. 3 Credits.

Offered autumn even-numbered years. Prereq., consent of instr. Theory and applications of optimization. Topics chosen from linear, non-linear, and discrete optimization, including duality theory, convexity and networks. Level: Graduate

M 584 - Topics in Combinatorics and Optimization. 3 Credits.

(R-12) Offered spring odd-numbered years. Prereq., consent of instr. Topics chosen from the areas of combinatorics and optimization. May include classical problems, current trends, research interests or other topics chosen by the instructor. Level: Graduate

M 593 - Professional Project. 1-6 Credits.

(R-6) Offered autumn and spring. Prereq., consent of advisor. Preparation of a professional paper appropriate to the needs and objectives of the individual student. Level: Graduate

M 595 - Special Topics. 1-12 Credits.

(R-12) Offered autumn and spring. Prereq., consent of instr. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics. Level: Graduate

M 596 - Independent Study. 1-12 Credits.

(R-12) Offered autumn and spring. Prereq., consent of instr. Course material appropriate to the needs and objectives of the individual student. Level: Graduate

M 597 - Research. 1-12 Credits.

(R-12) Offered autumn and spring. Prereq., consent of instr. Directed individual research and study appropriate to the background and objectives of the student. Level: Graduate

M 598 - Internship. 1-12 Credits.

(R-12) Offered autumn and spring. Prereq., consent of department. Extended classroom experience which provides practical application of classroom learning during placements off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. Level: Graduate

M 599 - Thesis. 1-6 Credits.

(R-6) Offered autumn and spring. Prereq., consent of instr. Preparation of a thesis or manuscript based on research for presentation and/or publication. Level: Graduate

M 600 - Mathematics Colloquium. 1-3 Credits.

(R-3) Offered autumn and spring. Prereq., consent of advisor. Presentations of research topics in mathematics and related fields. Level: Graduate

M 602 - Teaching College Mathematics. 3 Credits.

Prereq., second year standing in graduate school. Topics include publishing, grant writing, writing in mathematics classes, media use in mathematics, evaluation and assessment of curricular materials and programs, instructional methods in university mathematics courses, and other selected topics. Level: Graduate

M 605 - Learning Theories in Mathematics. 3 Credits.

Prereq., graduate status. How children learn mathematical content and processes. Models of mental development, concept formation, problem solving, reasoning, and creative thinking. Level: Graduate

M 609 - Research Methods in Mathematics Education. 3 Credits.

Prereq., Consent of instr. Resources for learning of reported research, critical reviews of research, quantitative and qualitative processes. Level: Graduate

M 610 - Graduate Seminar in Applied Mathematics. 1-12 Credits.

(R-12) Offered autumn and spring. Prereq., consent of instr. A review and discussion of current research. Level: Graduate

M 620 - Graduate Seminar in Algebra. 1-12 Credits.

(R-12) Offered autumn and spring. Prereq., consent of instr. Level: Graduate

M 650 - Graduate Seminar in Analysis. 1-12 Credits.

(R-12) Offered autumn and spring. Prereq., consent of instr. A review and discussion of current research. Level: Graduate

M 680 - Graduate Seminar in Combinatorics and Optimization. 1-12 Credits.

(R-12) Offered autumn and spring. Prereq., consent of instr. A review and discussion of current research. Level: Graduate

M 690 - Supervised Internship. 1-12 Credits.

(R-6) Offered autumn and spring. Prereq., consent of department. Supervised Teaching Internship. Level: Graduate

M 691 - Practicum. 3 Credits.

Prereq., consent of instr. Resources for learning of reported research, critical reviews of research, quantitative and qualitative processes. Level: Graduate

M 694 - Seminar. 1-12 Credits.

(R-12) Offered autumn and spring. Prereq., consent of instr. A review and discussion of current research. Topics vary. Level: Graduate

M 695 - Special Topics. 1-9 Credits.**M 699 - Dissertation. 1-9 Credits.**

(R-9) Offered autumn and spring. Level: Graduate