Mathematics Courses

Courses

MATH 101. Foundations of Algebra and Mathematical Modeling. 4 Credits.
Critical elements of pre-college algebra, topics including equation solving; rational, radical, and polynomial expression evaluation and simplification; lines, linear equations, and quadratic equations. Focus on mathematical modeling and preparation for additional college level mathematics.
Prereq: UO Math Placement Exam with a score of 35-48.

MATH 105Z. Math in Society. 4 Credits.
An exploration of present-day applications of mathematics focused on developing numeracy. Major topics include quantitative reasoning and problem-solving strategies, probability and statistics, and financial mathematics; these topics are to be weighted approximately equally. This course emphasizes mathematical literacy and communication, relevant everyday applications, and the appropriate use of current technology. Previously MATH 105.
Prereq: MATH 101 or satisfactory placement test score.

MATH 106. University Mathematics II. 4 Credits.
Topics include mathematics of finance, applied geometry, exponential growth and decay, and a nontechnical introduction to the concepts of calculus.
Prereq: MATH 101 or satisfactory placement test score.

MATH 107. University Mathematics III. 4 Credits.
Topics chosen from modular arithmetic and coding, tilings and symmetry, voting methods, apportionment, fair division, introductory graph theory, or scheduling.
Prereq: MATH 101 or satisfactory placement test score.

MATH 111Z. Precalculus I: Functions. 4 Credits.
A course primarily designed for students preparing for trigonometry or calculus. This course focuses on functions and their properties, including polynomial, rational, exponential, logarithmic, piecewise-defined, and inverse functions. These topics will be explored symbolically, numerically, and graphically in real-life applications and interpreted in context. This course emphasizes skill building, problem solving, modeling, reasoning, communication, connections with other disciplines, and the appropriate use of present-day technology. Previously MATH 111.
Prereq: MATH 101 or satisfactory placement test score.

MATH 112Z. Precalculus II: Trigonometry. 4 Credits.
A course primarily designed for students preparing for calculus and related disciplines. This course explores trigonometric functions and their applications as well as the language and measurement of angles, triangles, circles, and vectors. These topics will be explored symbolically, numerically, and graphically in real-life applications and interpreted in context. This course emphasizes skill building, problem solving, modeling, reasoning, communication, connections with other disciplines, and the appropriate use of present-day technology. Previously MATH 112.
Prereq: MATH 111Z or satisfactory placement test score.

MATH 199. Special Studies: [Topic]. 1-5 Credits.
Repeatable.

MATH 201. Algebra Math Lab. 2 Credits.
Exploratory course in mathematics. Course focuses on techniques of mathematical exploration and discovery, the language of mathematics, and foundational issues. Topics from algebra.

MATH 202. Geometry Math Lab. 2 Credits.
Exploratory course in mathematics. Course focuses on techniques of mathematical exploration and discovery, the language of mathematics, and foundational issues. Topics from geometry.

MATH 203. Analysis and Number Theory Math Lab. 2 Credits.
Exploratory course in mathematics. Course focuses on techniques of mathematical exploration and discovery, the language of mathematics, and foundational issues. Topics from analysis and the theory of numbers.

MATH 204. Probability and Statistics Math Lab. 2 Credits.
Exploratory course in mathematics. Course focuses on techniques of mathematical exploration and discovery, the language of mathematics, and foundational issues. Topics from probability and statistics.

MATH 205. Foundations Math Lab. 2 Credits.
Exploratory course in mathematics. Course focuses on techniques of mathematical exploration and discovery, the language of mathematics, and foundational issues. Topics from the foundations of mathematics.

MATH 206. Combinatorics Math Lab. 2 Credits.
Exploratory course in mathematics. Course focuses on techniques of mathematical exploration and discovery, the language of mathematics, and foundational issues. Topics from combinatorics.

MATH 211. Fundamentals of Elementary Mathematics I. 4 Credits.
Structure of the number system, logical thinking, topics in geometry, simple functions, and basic statistics and probability. Calculators, concrete materials, and problem solving are used when appropriate. Covers the mathematics needed to teach grades K–8. Sequence.
Prereq: MATH 101, MATH 111Z, or satisfactory placement score.

MATH 212. Fundamentals of Elementary Mathematics II. 4 Credits.
Structure of the number system, logical thinking, topics in geometry, simple functions, and basic statistics and probability. Calculators, concrete materials, and problem solving are used when appropriate. Covers the mathematics needed to teach grades K–8. Sequence.
Prereq: MATH 211.

MATH 213. Fundamentals of Elementary Mathematics III. 4 Credits.
Structure of the number system, logical thinking, topics in geometry, simple functions, and basic statistics and probability. Calculators, concrete materials, and problem solving are used when appropriate. Covers the mathematics needed to teach grades K–8. Sequence.
Prereq: MATH 212.

MATH 231. Elements of Discrete Mathematics I. 4 Credits.
Sets, mathematical logic, induction, sequences, and functions. Sequence.
Prereq: MATH 112Z or satisfactory placement test score.

MATH 232. Elements of Discrete Mathematics II. 4 Credits.
Relations, theory of graphs and trees with applications, permutations and combinations.
Prereq: MATH 231.

MATH 241. Calculus for Business and Social Science I. 4 Credits.
Introduction to topics in differential and integral calculus including some aspects of the calculus of several variables. Sequence. Students cannot receive credit for more than one of MATH 241, MATH 246, MATH 251.
Prereq: MATH 111 or satisfactory placement test score; a programmable calculator capable of displaying function graphs.

MATH 242. Calculus for Business and Social Science II. 4 Credits.
Introduction to topics in differential and integral calculus including some aspects of the calculus of several variables. Students cannot receive credit for more than one of MATH 242, MATH 247, MATH 252.
Prereq: MATH 241.

MATH 246. Calculus for the Biological Sciences I. 4 Credits.
For students in biological science and related fields. Emphasizes modeling and applications to biology. Differential calculus and applications. Sequence. Students cannot receive credit for more than one of MATH 241, MATH 246, MATH 251.
Prereq: MATH 112Z or satisfactory placement test score.

MATH 247. Calculus for the Biological Sciences II. 4 Credits.
For students in biological science and related fields. Emphasizes modeling and applications to biology. Integral calculus and applications. Students cannot receive credit for more than one of MATH 242, MATH 247, MATH 252.
Prereq: MATH 246.

MATH 251. Calculus I. 4 Credits.
Standard sequence for students of physical and social sciences and of mathematics. Differential calculus and applications. Students cannot receive credit for more than one of MATH 241, MATH 246, MATH 251. Sequence with MATH 252 and MATH 253.
Prereq: MATH 112Z or satisfactory placement test score.

MATH 252. Calculus II. 4 Credits.
Standard sequence for students of physical and social sciences and of mathematics. Integral calculus. Sequence. Students cannot receive credit for more than one of MATH 242, MATH 247, MATH 252.
Prereq: MATH 251.

MATH 253. Calculus III. 4 Credits.
Standard sequence for students of physical and social sciences and of mathematics. Introduction to improper integrals, infinite sequences and series, Taylor series, and differential equations. Sequence.
Prereq: MATH 252.

MATH 256. Introduction to Differential Equations. 4 Credits.
Introduction to differential equations and applications. Linear algebra is introduced as needed.
Prereq: MATH 253.

MATH 261. Calculus with Theory I. 4 Credits.
Covers both applications of calculus and its theoretical background. Axiomatic treatment of the real numbers, limits, and the least upper bound property.

MATH 262. Calculus with Theory II. 4 Credits.
Covers both applications of calculus and its theoretical background. Differential and integral calculus.
Prereq: MATH 261.

MATH 263. Calculus with Theory III. 4 Credits.
Covers both applications of calculus and its theoretical background. Sequences and series, Taylor's theorem.
Prereq: MATH 262.

MATH 281. Several-Variable Calculus I. 4 Credits.
Introduction to calculus of functions of several variables including partial differentiation; gradient, divergence, and curl; line and surface integrals; Green's and Stokes's theorems. Linear algebra introduced as needed. Sequence.
Prereq: MATH 253.

MATH 282. Several-Variable Calculus II. 4 Credits.
Introduction to calculus of functions of several variables including partial differentiation; gradient, divergence, and curl; line and surface integrals; Green's and Stokes's theorems. Linear algebra introduced as needed.
Prereq: MATH 281.

MATH 307. Introduction to Proof. 4 Credits.
Proof is how mathematics establishes truth and communicates ideas. Introduces students to proof in the context of interesting mathematical problems. Students cannot receive credit for both PHIL 225 and MATH 307.
Prereq: MATH 247 or MATH 252 or MATH 262.

MATH 316. Fundamentals of Analysis I. 4 Credits.
Rigorous treatment of topics introduced in calculus such as limits, sequences, series, the Cauchy condition, and continuity. Development of mathematical proof in these contexts. Sequence with MATH 317.
Prereq: MATH 253 or equivalent; one from MATH 232, MATH 262, MATH 307.

MATH 317. Fundamentals of Analysis II. 4 Credits.
Rigorous treatment of topics introduced in calculus such as continuity, uniform convergence, power series, differentiation, and integration. Development of mathematical proof in these contexts. Sequence with MATH 316.
Prereq: MATH 316.

MATH 320. Theory of Differential Equations. 4 Credits.
An introduction to differential equations for students with background in linear algebra, with a mixture of applications and theory. Topics include linear and nonlinear equations, systems of equations, and questions of existence and uniqueness.
Prereq: MATH 281, MATH 342; one from MATH 232, MATH 262, MATH 307.

MATH 341. Elementary Linear Algebra. 4 Credits.
Vector and matrix algebra; n-dimensional vector spaces; systems of linear equations; linear independence and dimension; linear transformations; rank and nullity; determinants; eigenvalues; inner product spaces; theory of a single linear transformation. Sequence.
Prereq: MATH 252. MATH 253 is recommended.

MATH 342. Elementary Linear Algebra. 4 Credits.
Vector and matrix algebra; n-dimensional vector spaces; systems of linear equations; linear independence and dimension; linear transformations; rank and nullity; determinants; eigenvalues; inner product spaces; theory of a single linear transformation.
Prereq: MATH 341.

MATH 343. Statistical Models and Methods. 4 Credits.
Review of theory and applications of mathematical statistics including estimation and hypothesis testing. Students cannot get credit for both MATH 343 and DSCI 345M/MATH 345M.
Prereq: MATH 252.

MATH 345M. Probability and Statistics for Data Science. 4 Credits.
Introduction to probability and statistics, with an emphasis upon topics relevant for data science. Multilisted with DSCI 345M. Students cannot get credit for both MATH 343 and DSCI 345M/MATH 345M.
Prereq: MATH 342, CS 211.

MATH 347. Fundamentals of Number Theory I. 4 Credits.
A study of congruences, the Chinese remainder theorem, the theory of prime numbers and divisors, Diophantine equations, and quadratic reciprocity. Development of mathematical proof in these contexts. Sequence with MATH 348.
Prereq: MATH 253 or equivalent; one from MATH 232, MATH 262, MATH 307.

MATH 348. Fundamentals of Number Theory II. 4 Credits.
Study of nonlinear Diophantine equations, sums of squares, the theory of partitions, geometric number theory, and the distribution of prime numbers. Development of mathematical proof in these contexts. Sequence with MATH 347.
Prereq: MATH 347.

MATH 351. Elementary Numerical Analysis I. 4 Credits.
Basic techniques of numerical analysis and their use on computers. Topics include root approximation, linear systems, interpolation, integration, and differential equations. Sequence.
Prereq: MATH 253 or equivalent; one from MATH 232, MATH 262, MATH 307.

MATH 352. Elementary Numerical Analysis II. 4 Credits.
Basic techniques of numerical analysis and their use on computers. Topics include root approximation, linear systems, interpolation, integration, and differential equations.
Prereq: MATH 351.

MATH 391. Fundamentals of Abstract Algebra I. 4 Credits.
Introduction to algebraic structures including groups, rings, fields, and polynomial rings. Sequence.
Prereq: MATH 341; one from MATH 232, MATH 262, MATH 307.

MATH 392. Fundamentals of Abstract Algebra II. 4 Credits.
Introduction to algebraic structures including groups, rings, fields, and polynomial rings.
Prereq: MATH 391.

MATH 394. Geometries from an Advanced Viewpoint I. 4 Credits.
Topics in Euclidean geometry in two and three dimensions including constructions. Emphasizes investigations, proofs, and challenging problems. For prospective secondary and middle school teachers.
Prereq: MATH 253 or equivalent; one from MATH 232, MATH 262, MATH 307.

MATH 395. Geometries from an Advanced Viewpoint II. 4 Credits.
Analysis of problems in Euclidean geometry using coordinates, vectors, and the synthetic approach. Transformations in the plane and space and their groups. Introduction to non-Euclidean geometries. For prospective secondary teachers.
Prereq: MATH 394.

MATH 397. History and Applications of Calculus. 4 Credits.
Historical applications of calculus. Topics may include volumes by the method of exhaustion, Archimedean spiral, Kepler problem, calculus of variations, brachistochrone problem, spread of infectious disease, analysis of savings.
Prereq: MATH 253; one from MATH 232, MATH 262, MATH 307.

MATH 399. Special Studies: [Topic]. 1-5 Credits.
Repeatable.

MATH 401. Research: [Topic]. 1-21 Credits.
Repeatable.

MATH 403. Thesis. 1-4 Credits.
Repeatable.

MATH 405. Reading and Conference: [Topic]. 1-4 Credits.
Repeatable.

MATH 407. Seminar: [Topic]. 1-4 Credits.
Repeatable.

MATH 410. Experimental Course: [Topic]. 1-5 Credits.
Repeatable.

MATH 411. Functions of a Complex Variable I. 4 Credits.
Complex numbers, linear fractional transformations, Cauchy-Riemann equations, Cauchy's theorem and applications, power series, residue theorem, harmonic functions, contour integration, conformal mapping, infinite products. Sequence.
Prereq: MATH 281; one from MATH 232, MATH 262, MATH 307.

MATH 412. Functions of a Complex Variable II. 4 Credits.
Complex numbers, linear fractional transformations, Cauchy-Riemann equations, Cauchy's theorem and applications, power series, residue theorem, harmonic functions, contour integration, conformal mapping, infinite products.
Prereq: MATH 411.

MATH 413. Introduction to Analysis I. 4 Credits.
Differentiation and integration on the real line and in a dimensional Euclidean space; normed linear spaces and metric spaces; vector field theory and differential forms. Sequence.
Prereq: MATH 282, MATH 317.

MATH 414. Introduction to Analysis II. 4 Credits.
Differentiation and integration on the real line and in a dimensional Euclidean space; normed linear spaces and metric spaces; vector field theory and differential forms.
Prereq: MATH 413.

MATH 415. Introduction to Analysis III. 4 Credits.
Differentiation and integration on the real line and in a dimensional Euclidean space; normed linear spaces and metric spaces; vector field theory and differential forms. Sequence.
Prereq: MATH 414.

MATH 421M. Partial Differential Equations: Fourier Analysis I. 4 Credits.
Introduction to PDEs with a view towards applications in physics. Wave and heat equations, classical Fourier series on the circle, Bessel and Legendre series. Multilisted with PHYS 421M.
Prereq: MATH 253; one from MATH 256, MATH 281.

MATH 422. Partial Differential Equations: Fourier Analysis II. 4 Credits.
General theory of PDEs; the Fourier transform. Laplace and Poisson equations; Green's functions and application. Mean value theorem and max-min principle.
Prereq: MATH 421M or PHYS 421M.

MATH 425. Statistical Methods I. 4 Credits.
Statistical methods for upper-division and graduate students anticipating research in nonmathematical disciplines. Presentation of data, sampling distributions, tests of significance, confidence intervals, linear regression, analysis of variance, correlation, statistical software. Sequence. Only nonmajors and nonminors may receive upper-division credit. Students cannot receive credit for both STAT 243Z and MATH 425.
Prereq: MATH 111Z or satisfactory placement test score.

MATH 431. Introduction to Topology I. 4 Credits.
Elementary point-set topology with an introduction to combinatorial topology and homotopy. Sequence with MATH 432, MATH 434.
Prereq: MATH 317.

MATH 432. Introduction to Topology II. 4 Credits.
Introduction to differential topology and de Rham cohomology. Sequence with MATH 431, MATH 434.
Prereq: MATH 281, MATH 341, MATH 431.

MATH 433. Introduction to Differential Geometry. 4 Credits.
Plane and space curves, Frenet-Serret formula surfaces. Local differential geometry, Gauss-Bonnet formula, introduction to manifolds.
Prereq: MATH 282, 342; one from MATH 232, MATH 262, MATH 307.

MATH 434. Introduction to Topology III. 4 Credits.
Introduction to differential topology and de Rham cohomology. Sequence.
Prereq: MATH 432.

MATH 441. Linear Algebra. 4 Credits.
Theory of vector spaces over arbitrary fields, theory of a single linear transformation, minimal polynomials, Jordan and rational canonical forms, quadratic forms, quotient spaces.
Prereq: MATH 342; one from MATH 232, MATH 262, MATH 307.

MATH 444. Introduction to Abstract Algebra I. 4 Credits.
Theory of groups, rings, and fields. Polynomial rings, unique factorization, and Galois theory. Sequence.
Prereq: MATH 342; one from MATH 232, MATH 262, MATH 307.

MATH 445. Introduction to Abstract Algebra II. 4 Credits.
Theory of groups, rings, and fields. Polynomial rings, unique factorization, and Galois theory.
Prereq: MATH 444.

MATH 446. Introduction to Abstract Algebra III. 4 Credits.
Theory of groups, rings, and fields. Polynomial rings, unique factorization, and Galois theory.
Prereq: MATH 445.

MATH 456. Networks and Combinatorics. 4 Credits.
Fundamentals of modern combinatorics; graph theory; networks; trees; enumeration, generating functions, recursion, inclusion and exclusion; ordered sets, lattices, Boolean algebras.
Prereq: one from MATH 232, MATH 262, MATH 307.

MATH 458. Introduction to Mathematical Cryptography. 4 Credits.
Mathematical theory of public key cryptography. Finite field arithmetic, RSA and Diffie-Hellman algorithms, elliptic curves, generation of primes, factorization techniques. Offered alternate years.
Prereq: MATH 341.

MATH 461. Introduction to Mathematical Methods of Statistics I. 4 Credits.
Discrete and continuous probability models; useful distributions; applications of moment-generating functions; sample theory with applications to tests of hypotheses, point and confidence interval estimates. Sequence.
Prereq: MATH 253 or MATH 263; one from MATH 232, MATH 262, MATH 307.

MATH 462. Introduction to Mathematical Methods of Statistics II. 4 Credits.
Discrete and continuous probability models; useful distributions; applications of moment-generating functions; sample theory with applications to tests of hypotheses, point and confidence interval estimates.
Prereq: MATH 461.

MATH 463. Mathematical Methods of Regression Analysis and Analysis of Variance. 4 Credits.
Multinomial distribution and chi-square tests of fit, simple and multiple linear regression, analysis of variance and covariance, methods of model selection and evaluation, use of statistical software.
Prereq: MATH 342, MATH 462.

MATH 467. Stochastic Processes. 4 Credits.
Basics of stochastic processes including Markov chains, martingales, Poisson processes, Brownian motion and their applications.
Prereq: MATH 341, MATH 461.

MATH 497M. Deterministic Dynamical Modeling in Biology. 4 Credits.
This course covers deterministic dynamical models in biology, i.e., models that describe the behavior of a biological system over time as a result of internal feedback loops and external forcings. The focus will be on differential equations, discrete-time models and related computational (programming) tools. Multilisted with BI 497M.
Prereq: One from MATH 242, MATH 247, MATH 252, MATH 262, MATH 320; one from MATH 243, DSCI 345M, MATH 345M, MATH 461, MATH 467.

MATH 499M. Stochastic Dynamical Modeling in Biology. 4 Credits.
This course covers stochastic dynamical models in biology, i.e., mathematical models that describe the behavior of non-deterministic biological systems as a result of internal feedback loops, external forcings and random processes. Topics include stochastic iterative maps, Markov chains, vector autoregression models, and time series analysis. Multilisted with BI 499M.
Prereq: One from MATH 242, MATH 247, MATH 252, MATH 262, MATH 320; one from MATH 243, DSCI 345M, MATH 345M, MATH 461, MATH 467. Basic programming skills recommended.

MATH 503. Thesis. 1-12 Credits.
Repeatable.

MATH 507. Seminar: [Topic]. 1-4 Credits.
Repeatable.

MATH 510. Experimental Course: [Topic]. 1-5 Credits.
Repeatable.

MATH 511. Functions of a Complex Variable I. 4 Credits.
Complex numbers, linear fractional transformations, Cauchy-Riemann equations, Cauchy's theorem and applications, power series, residue theorem, harmonic functions, contour integration, conformal mapping, infinite products. Sequence.

MATH 512. Functions of a Complex Variable II. 4 Credits.
Complex numbers, linear fractional transformations, Cauchy-Riemann equations, Cauchy's theorem and applications, power series, residue theorem, harmonic functions, contour integration, conformal mapping, infinite products.
Prereq: MATH 511.

MATH 513. Introduction to Analysis I. 4 Credits.
Differentiation and integration on the real line and in a dimensional Euclidean space; normed linear spaces and metric spaces; vector field theory and differential forms. Sequence.

MATH 514. Introduction to Analysis II. 4 Credits.
Differentiation and integration on the real line and in a dimensional Euclidean space; normed linear spaces and metric spaces; vector field theory and differential forms. Sequence.
Prereq: MATH 513.

MATH 515. Introduction to Analysis III. 4 Credits.
Differentiation and integration on the real line and in a dimensional Euclidean space; normed linear spaces and metric spaces; vector field theory and differential forms. Sequence.
Prereq: MATH 514.

MATH 521M. Partial Differential Equations: Fourier Analysis I. 4 Credits.
Introduction to PDEs with a view towards applications in physics. Wave and heat equations, classical Fourier series on the circle, Bessel and Legendre series. Multilisted with PHYS 521M.

MATH 522. Partial Differential Equations: Fourier Analysis II. 4 Credits.
General theory of PDEs; the Fourier transform. Laplace and Poisson equations; Green's functions and application. Mean value theorem and max-min principle.
Prereq: MATH 421/521.

MATH 525. Statistical Methods I. 4 Credits.
Statistical methods for upper-division and graduate students anticipating research in nonmathematical disciplines. Presentation of data, sampling distributions, tests of significance, confidence intervals, linear regression, analysis of variance, correlation, statistical software. Sequence. Only nonmajors may receive graduate credit.

MATH 531. Introduction to Topology I. 4 Credits.
Elementary point-set topology with an introduction to combinatorial topology and homotopy. Sequence with MATH 532, MATH 534.

MATH 532. Introduction to Topology II. 4 Credits.
Introduction to differential topology and de Rham cohomology. Sequence with MATH 531, MATH 534.
Prereq: MATH 531.

MATH 533. Introduction to Differential Geometry. 4 Credits.
Plane and space curves, Frenet-Serret formula surfaces. Local differential geometry, Gauss-Bonnet formula, introduction to manifolds.

MATH 534. Introduction to Topology III. 4 Credits.
Introduction to differential topology and de Rham cohomology. Sequence with MATH 531, MATH 532.
Prereq: MATH 352.

MATH 541. Linear Algebra. 4 Credits.
Theory of vector spaces over arbitrary fields, theory of a single linear transformation, minimal polynomials, Jordan and rational canonical forms, quadratic forms, quotient spaces.

MATH 544. Introduction to Abstract Algebra I. 4 Credits.
Theory of groups, rings, and fields. Polynomial rings, unique factorization, and Galois theory. Sequence.

MATH 545. Introduction to Abstract Algebra II. 4 Credits.
Theory of groups, rings, and fields. Polynomial rings, unique factorization, and Galois theory.
Prereq: MATH 544.

MATH 546. Introduction to Abstract Algebra III. 4 Credits.
Theory of groups, rings, and fields. Polynomial rings, unique factorization, and Galois theory.
Prereq: MATH 545.

MATH 556. Networks and Combinatorics. 4 Credits.
Fundamentals of modern combinatorics; graph theory; networks; trees; enumeration, generating functions, recursion, inclusion and exclusion; ordered sets, lattices, Boolean algebras.

MATH 561. Introduction to Mathematical Methods of Statistics I. 4 Credits.
Discrete and continuous probability models; useful distributions; applications of moment-generating functions; sample theory with applications to tests of hypotheses, point and confidence interval estimates. Sequence.

MATH 562. Introduction to Mathematical Methods of Statistics II. 4 Credits.
Discrete and continuous probability models; useful distributions; applications of moment-generating functions; sample theory with applications to tests of hypotheses, point and confidence interval estimates.
Prereq: MATH 561.

MATH 563. Mathematical Methods of Regression Analysis and Analysis of Variance. 4 Credits.
Multinomial distribution and chi-square tests of fit, simple and multiple linear regression, analysis of variance and covariance, methods of model selection and evaluation, use of statistical software.
Prereq: MATH 562.

MATH 567. Stochastic Processes. 4 Credits.
Basics of stochastic processes including Markov chains, martingales, Poisson processes, Brownian motion and their applications.
Prereq: MATH 561.

MATH 597M. Deterministic Dynamical Modeling in Biology. 4 Credits.
This course covers deterministic dynamical models in biology, i.e., models that describe the behavior of a biological system over time as a result of internal feedback loops and external forcings. The focus will be on differential equations, discrete-time models and related computational (programming) tools. Multilisted with BI 597M.

MATH 599M. Stochastic Dynamical Modeling in Biology. 4 Credits.
This course covers stochastic dynamical models in biology, i.e., mathematical models that describe the behavior of non-deterministic biological systems as a result of internal feedback loops, external forcings and random processes. Topics include stochastic iterative maps, Markov chains, vector autoregression models, and time series analysis. Multilisted with BI 599M.

MATH 600M. Temporary Mulitlisted Course. 1-5 Credits.
Repeatable.

MATH 601. Research: [Topic]. 1-9 Credits.
Repeatable.

MATH 603. Dissertation. 1-16 Credits.
Repeatable.

MATH 604. Internship: [Topic]. 1-9 Credits.
Repeatable.

MATH 605. Reading and Conference: [Topic]. 1-16 Credits.
Repeatable.

MATH 607. Seminar: [Topic]. 1-5 Credits.
Repeatable. Topics include Advanced Topics in Geometry, Ring Theory, Teaching Mathematics.

MATH 610. Experimental Course: [Topic]. 1-5 Credits.
Repeatable.

MATH 616. Real Analysis. 4-5 Credits.
Measure and integration theory, differentiation, and functional analysis with point-set topology as needed. Sequence.

MATH 617. Real Analysis. 4-5 Credits.
Measure and integration theory, differentiation, and functional analysis with point-set topology as needed. Sequence.
Prereq: MATH 616.

MATH 618. Real Analysis. 4-5 Credits.
Measure and integration theory, differentiation, and functional analysis with point-set topology as needed. Sequence.
Prereq: MATH 617.

MATH 619. Complex Analysis. 4-5 Credits.
The theory of Cauchy, power series, contour integration, entire functions, and related topics.

MATH 634. Algebraic Topology. 4-5 Credits.
Development of homotopy, homology, and cohomology with point-set topology as needed. Sequence.

MATH 635. Algebraic Topology. 4-5 Credits.
Development of homotopy, homology, and cohomology with point-set topology as needed. Sequence.
Prereq: MATH 634.

MATH 636. Algebraic Topology. 4-5 Credits.
Development of homotopy, homology, and cohomology with point-set topology as needed. Sequence.
Prereq: MATH 635.

MATH 637. Differential Geometry. 4-5 Credits.
Topics include curvature and torsion, Serret-Frenet formulas, theory of surfaces, differentiable manifolds, tensors, forms and integration. Sequence.

MATH 638. Differential Geometry. 4-5 Credits.
Topics include curvature and torsion, Serret-Frenet formulas, theory of surfaces, differentiable manifolds, tensors, forms and integration. Sequence.
Prereq: MATH 637.

MATH 639. Differential Geometry. 4-5 Credits.
Topics include curvature and torsion, Serret-Frenet formulas, theory of surfaces, differentiable manifolds, tensors, forms and integration. Sequence.

MATH 647. Abstract Algebra. 4-5 Credits.
Group theory, fields, Galois theory, algebraic numbers, matrices, rings, algebras. Sequence.

MATH 648. Abstract Algebra. 4-5 Credits.
Group theory, fields, Galois theory, algebraic numbers, matrices, rings, algebras. Sequence.
Prereq: MATH 647.

MATH 649. Abstract Algebra. 4-5 Credits.
Group theory, fields, Galois theory, algebraic numbers, matrices, rings, algebras. Sequence.
Prereq: MATH 648.

MATH 672. Theory of Probability. 4-5 Credits.
Measure and integration, probability spaces, laws of large numbers, central-limit theory, conditioning, martingales, random walks.
Prereq: MATH 671.

MATH 673. Theory of Probability. 4-5 Credits.
Measure and integration, probability spaces, laws of large numbers, central-limit theory, conditioning, martingales, random walks.
Prereq: MATH 672.

MATH 681. Advanced Algebra: [Topic]. 4-5 Credits.
Repeatable. Topics selected from theory of finite groups, representations of finite groups, Lie groups, Lie algebras, algebraic groups, ring theory, algebraic number theory.

MATH 682. Advanced Algebra: [Topic]. 4-5 Credits.
Repeatable. Topics selected from theory of finite groups, representations of finite groups, Lie groups, Lie algebras, algebraic groups, ring theory, algebraic number theory.

MATH 683. Advanced Algebra: [Topic]. 4-5 Credits.
Repeatable. Topics selected from theory of finite groups, representations of finite groups, Lie groups, Lie algebras, algebraic groups, ring theory, algebraic number theory.

MATH 684. Advanced Analysis: [Topic]. 4-5 Credits.
Repeatable. Topics selected from Banach algebras, operator theory, functional analysis, harmonic analysis on topological groups, theory of distributions.

MATH 685. Advanced Analysis: [Topic]. 4-5 Credits.
Repeatable. Topics selected from Banach algebras, operator theory, functional analysis, harmonic analysis on topological groups, theory of distributions.

MATH 686. Advanced Analysis: [Topic]. 4-5 Credits.
Repeatable. Topics selected from Banach algebras, operator theory, functional analysis, harmonic analysis on topological groups, theory of distributions.

MATH 690. Advanced Geometry and Topology: [Topic]. 4-5 Credits.
Repeatable. Topics selected from classical and local differential geometry; symmetric spaces; low-dimensional topology; differential topology; global analysis; homology, cohomology, and homotopy; differential analysis and singularity theory; knot theory.

MATH 691. Advanced Geometry and Topology: [Topic]. 4-5 Credits.
Repeatable. Topics selected from classical and local differential geometry; symmetric spaces; low-dimensional topology; differential topology; global analysis; homology, cohomology, and homotopy; differential analysis and singularity theory; knot theory.

MATH 692. Advanced Geometry and Topology: [Topic]. 4-5 Credits.
Repeatable. Topics selected from classical and local differential geometry; symmetric spaces; low-dimensional topology; differential topology; global analysis; homology, cohomology, and homotopy; differential analysis and singularity theory; knot theory.