

MATHEMATICS (MATH)

MATH 112. Introduction to Mathematical Modeling. 1 Credit.

Offered Spring Semester Only; Lecture hours:3

Introduction for the non-specialist to mathematical modeling of real-world phenomena such as voting and networks, using graph theory, probability, and other accessible tools.

MATH 150. Calculus Preparation. .5 Credits.

Offered Fall Semester Only; Lecture hours:3

Exploration of algebraic, exponential, logarithmic and trigonometric functions. Review and use of tools from differential calculus, including limits, to better understand those function classes. Emphasis on modeling and problem-solving techniques. Prerequisite: permission of the instructor.

MATH 192. Topics in Calculus. 1 Credit.

Offered Both Fall and Spring, TLC Tutoring Course; Lecture hours:3

Elementary calculus and applications taken primarily from economics. Topics include algebraic, exponential, and logarithmic functions, graphs, limits, regular and partial derivatives, constrained optimization, and integration. Not open to students who have MATH 201 credit.

MATH 201. Calculus I. 1 Credit.

Offered Both Fall and Spring, TLC Tutoring Course; Lecture hours:4

An introduction to the calculus of algebraic, trigonometric and transcendental functions. Interpretation, significance and calculations of derivatives. Applications to geometry, biology, physics, economics, and other subjects. Introduction to the integral, including the Fundamental Theorem of Calculus and substitution. Not open to students who have MATH 192 credit.

MATH 202. Calculus II. 1 Credit.

Offered Both Fall and Spring, TLC Tutoring Course; Lecture hours:4

Methods of integration including integration by parts, numerical approximations, and improper integrals. Sequences and series, including Taylor series. Polar coordinates, parametric functions, differential equations, and applications. Prerequisite: MATH 201.

MATH 203. Introduction to Mathematical Thought. 1 Credit.

Offered Fall Semester Only; Lecture hours:3, Lab:1.5

An investigation of number, numeration, and operations from the perspective of elementary school teachers and pupils. Open only to B.S. in Education Early Childhood students. Required fieldwork.

MATH 204. Elementary Geometry and Statistics. 1 Credit.

Offered Spring Semester Only; Lecture hours:3, Other:1.5

Investigation of geometric, probabilistic, and statistical concepts related to elementary mathematics and how children learn and make sense of these concepts. Required fieldwork. Prerequisites: MATH 203 or permission of the instructor.

MATH 207. The Teaching of Mathematics in Secondary Schools. 1 Credit.

Offered Fall Semester Only; Lecture hours:3, Other:1.5

Investigation into the components of effective secondary school mathematics instruction, including lesson design/ implementation (curriculum, tasks, discourse, and assessment). Required fieldwork. Prerequisite: EDUC 102 or EDUC 201 or permission of the instructor.

MATH 208. Mathematical Explorations. .5 Credits.

Offered Fall Semester Only; Lecture hours:3

An exploration of topics from pure mathematics, applied mathematics and statistics, illustrating the power and beauty of mathematical reasoning. For students considering a major in mathematics. Corequisites: MATH 201 or MATH 202 or MATH 211 or MATH 212 or MATH 216. Open to first-year students only.

MATH 211. Calculus III. 1 Credit.

Offered Both Fall and Spring, TLC Tutoring Course; Lecture hours:4

Calculus of vector-valued functions and functions of several variables. Multiple, line, and surface integrals; applications, and extrema. Green's, Stokes' and Divergence Theorems. Prerequisite: MATH 202.

MATH 212. Differential Equations. 1 Credit.

Offered Both Fall and Spring, TLC Tutoring Course; Lecture hours:3

Basic methods of solving ordinary differential equations. Systems of linear differential equations, Laplace transform, applications and selected topics. Prerequisite: MATH 211. Not open to students who have taken MATH 222.

MATH 216. Statistics I. 1 Credit.

Offered Both Fall and Spring, TLC Tutoring Course; Lecture hours:3, Other:1

Exploratory data analysis, sampling and experimental designs, sampling distributions and confidence intervals, hypothesis testing, least squares regression and applications. Statistical software is used and a semester long project with real data is undertaken. Not open to students who have MATH 226, MATH 227, ENGR 226 or PSYC 215 credit.

MATH 217. Statistics II. 1 Credit.**Offered Both Fall and Spring; Lecture hours:3,Other:1**

Multiple linear regression, logistic regression and ANOVA. Inferential analysis emphasizing applications to a range of disciplines is conducted using statistical software. Prerequisite: MATH 216 or MATH 227 or equivalent. Students who have taken MATH 405 need instructor permission.

MATH 219. Topics in Applied Mathematics. 1 Credit.**Offered Occasionally; Lecture hours:3; Repeatable**

Topics such as financial mathematics, mathematical biology, cryptography, social networks, etc. Topic varies by semester. Prerequisite: varies by topic.

MATH 222. Differential Equations for Engineers. .5 Credits.**TLC Tutoring Course,Offered Spring Semester Only; Lecture hours:3**

First order differential equations, second order linear equations, higher order linear equations, numerical approximations. Prerequisite: MATH 211. Open only to civil engineering and environmental engineering students. Not open to students who have MATH 212 credit.

MATH 227. Statistics and Engineering. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3**

Probability theory, discrete and continuous random variables, sampling distributions and methods of statistical inference including regression and ANOVA. Software is used. Prerequisite: MATH 202. Open only to engineering students and students in computer science. Not open to students who have MATH 216 or ENGR 226 credit.

MATH 230. Data Visualization & Computing. 1 Credit.**Offered Spring Semester Only; Lecture hours:3**

Simulation-based learning for concepts including sampling, sampling distributions, p-values, and confidence levels. Data visualization beyond simple exploratory data analysis techniques. Advanced statistical software will be used. Prerequisite: MATH 216 or MATH 227 or permission of the instructor.

MATH 240. Applied Combinatorics. .5 Credits.**Offered Spring Semester Only; Lecture hours:3**

Counting techniques and traversal problems. Students join MATH 241 mid-semester. Pre- or co-requisite: MATH 280. Only for computer science students or students seeking secondary certification. Not open to students who have taken MATH 340.

MATH 241. Discrete Structures. 1 Credit.**TLC Tutoring Course,Offered Spring Semester Only; Lecture hours:3**

Logic, sets; mathematical induction; relations, functions; combinatorics and graph theory. Not open to students with MATH 240 or MATH 280 credit. Prerequisite: MATH 202.

MATH 245. Linear Algebra. 1 Credit.**Offered Both Fall and Spring,TLC Tutoring Course; Lecture hours:3**

Linear equations, matrices, vector spaces, linear transformations, eigenvalues, inner products, Gram-Schmidt algorithm, singular value decomposition. Prerequisite: MATH 202.

MATH 280. Logic, Sets, and Proofs. 1 Credit.**Offered Both Fall and Spring; Lecture hours:3**

Logic, sets; proof techniques; relations, functions, sequences and convergence; cardinality. Skills and tools for independent reading, problem solving and exploration. Not open to students with MATH 241 credit. Prerequisite: MATH 211 or MATH 245.

MATH 291. Undergraduate Readings. .25-2 Credits.**Offered Either Fall or Spring; Lecture hours:Varies; Repeatable**

Readings and research in special topics at an intermediate level. Prerequisites: permission of the instructor, adviser, and department chair.

MATH 303. Probability. 1 Credit.**Offered Both Fall and Spring; Lecture hours:3**

Elementary probability, random variables, moments, central limit theorem, conditional expectation, statistical distributions derived from the normal distribution. History of the development of Probability. Probability simulations and applications from various fields. Prerequisite: MATH 211.

MATH 304. Statistical Inference Theory. 1 Credit.**Offered Both Fall and Spring; Lecture hours:3**

Point and interval estimation, Fisher's likelihood theory, hypothesis testing, simulation techniques. R or SAS will be used. Prerequisites: MATH 216 or MATH 227 and MATH 303, or permission of the instructor.

MATH 306. Statistical & Data Science Consulting. 1 Credit.**Offered Fall Semester Only; Lecture hours:3**

Experiential learning course where students work on collaborative data focused projects. Students will communicate findings to stakeholders and engage with important topics related to the art and practice of statistical consulting. Advanced statistical software will be used. Prerequisites: MATH 217 and MATH 230, or permission of the instructor.

MATH 308. Real Analysis I. 1 Credit.**Offered Both Fall and Spring; Lecture hours:3**

Real numbers and elementary topology of Cartesian spaces, convergence, continuity, and differentiation. Prerequisites: MATH 211, MATH 245, and MATH 280.

MATH 311. Theory of Numbers. 1 Credit.**Offered Alternate Fall or Spring; Lecture hours:3**

Classical number theory in an algebraic setting. Topics include unique factorization, diophantine equations, and linear and quadratic congruences. Advanced topics from algebraic or analytic number theory. Prerequisites: MATH 245 and either MATH 241 or MATH 280 or permission of the instructor.

MATH 319. Topics in Advanced Mathematics. 1 Credit.**Offered Alternate Fall or Spring; Lecture hours:3; Repeatable**

Special topics, to be selected from algebra, analysis, geometry, statistics, applied mathematics, etc. Prerequisite varies by topic.

MATH 320. Abstract Algebra I. 1 Credit.**Offered Both Fall and Spring; Lecture hours:3**

Groups and rings; homomorphisms, isomorphism theorems; history of the development of algebra. Additional selected topics. Prerequisites: MATH 245 and MATH 280.

MATH 333. Topology. 1 Credit.**Offered Alternating Fall Semester; Lecture hours:3**

Topological spaces, connectedness, compactness, continuity, separation, and countability axioms. Metric, product, function, and uniform spaces. Prerequisites: MATH 211 and MATH 280, or permission of the instructor.

MATH 335. Geometry. 1 Credit.**Offered Alternating Fall Semester; Lecture hours:3**

Historical and axiomatic foundations of geometry. Euclidean and non-Euclidean geometries. Prerequisite: MATH 280 or permission of the instructor.

MATH 340. Combinatorics & Graph Theory. 1 Credit.**Offered Alternating Spring Semester; Lecture hours:3**

An introduction to combinatorics and graph theory. Topics include counting techniques, permutations, binomial coefficients, partitions, generating functions, graph traversal, spanning trees, matching theory, planar graphs; additional selected topics. Prerequisite: MATH 280 or permission of the instructor.

MATH 342. Topics in Finance or Industry. 1 Credit.**Offered Alternating Spring Semester; Lecture hours:3**

Possible topics include industrial mathematics, financial mathematics, genetic algorithms, simulations, and network analysis. Will also include applications to economics and the writing and presenting of a project. Prerequisites: CSCI 203, MATH 245, and MATH 303 or permission of the instructor.

MATH 343. Numerical Analysis. 1 Credit.**Offered Fall Semester Only; Lecture hours:3, Lab:2**

Floating point arithmetic, development of computational algorithms and error estimates for root approximation, interpolation and approximation by polynomials, numerical differentiation and integration, cubic splines, least-squares, linear systems. Lab component. Prerequisites: Two of (MATH 211, MATH 241, MATH 245, MATH 280) and (CSCI 203 or CSCI 204). Crosslisted as MATH 643.

MATH 345. Advanced Linear Algebra. 1 Credit.**Offered Alternate Fall or Spring; Lecture hours:3**

Rigorous treatment of linear algebra, including vector spaces, linear independence, span, basis, linear maps, matrices, eigenvalues, eigenvectors, inner products, the spectral theorem (complex and real). Additional topics may include: singular value decomposition, Jordan canonical form, various applications. Prerequisites: MATH 245 and either MATH 280 or permission of the instructor.

MATH 350. Partial Differential Equations. 1 Credit.**Offered Alternate Fall or Spring; Lecture hours:3**

Partial Differential Equations (PDEs) including the heat equation, wave equation, and Laplace's equation; existence and uniqueness of solutions to PDEs via the maximum principle and energy methods; method of characteristics; Fourier series and integral transforms; separation of variables; Sturm-Liouville theory and orthogonal expansions. Prerequisites: junior or senior status; MATH 212.

MATH 354. Modern Data Analysis. 1 Credit.**Offered Alternating Fall Semester; Lecture hours:3**

Advanced methods in modern data analysis. Topics may include principal component analysis, random forest, clustering and classification, unsupervised learning, splines, longitudinal data analysis, survival analysis, time series, spatial statistics, and nonparametric methods. Prerequisite: MATH 230 and MATH 245, or permission of the instructor.

MATH 358. Topics in Operations Research. 1 Credit.**Offered Spring Semester Only; Lecture hours:3**

Mathematical techniques in operations research. Stochastic processes and mathematical optimization. Topics may include Markov chains, queueing theory, simulation, linear programming, non-linear programming, integer programming, network optimization. Methods and applications drawn from various fields. Prerequisite: MATH 227 or MATH 303 or permission of the instructor. Crosslisted as MATH 658.

MATH 362. Complex Analysis. 1 Credit.

Offered Alternating Spring Semester; Lecture hours:3

Limits, analytic functions, integrals including contour integrals. Cauchy's Integral Theorem, entire functions and singularities. Prerequisites: MATH 211 and MATH 280, or permission of the instructor.

MATH 378. Seminar. .5 Credits.

Offered Either Fall or Spring; Lecture hours:2; Repeatable

Seminar based on topics from algebra, analysis, topology, differential equations, statistics, or applied mathematics; topics selected according to demand or interest. Prerequisite: permission of the instructor.

MATH 391. Reading and Research. .5-2 Credits.

Offered Either Fall or Spring; Lecture hours:Varies; Repeatable

Reading and research in various topics for qualified undergraduate students. Prerequisite: permission of the instructor.

MATH 405. Statistical Modeling. 1 Credit.

Offered Fall Semester Only; Lecture hours:3

Theory behind General Linear Models including multiple linear regression and logistic regression. Model diagnostics and remediation. Model selection, multicollinearity. R or SAS will be used. Prerequisites: MATH 245 and MATH 304.

MATH 407. Experimental Design. 1 Credit.

Offered Spring Semester Only; Lecture hours:3

Basic and advanced experimental designs (completely randomized, block, crossed, nested and mixed designs, fractional factorial, incomplete block, etc). Corresponding theory and application of estimation procedures including both frequentist and Bayesian estimation techniques. Advanced statistical software will be used. Prerequisite: MATH 304.

MATH 409. Real Analysis II. 1 Credit.

Offered Alternate Fall or Spring; Lecture hours:3

Continuation of MATH 308. Integration theory and advanced topics in analysis. Prerequisite: MATH 308.

MATH 416. Advanced Methods in Mathematical Modeling. 1 Credit.

Offered Alternate Fall or Spring; Lecture hours:3

A survey of mathematical models grounded in differential equations and methods used to analyze the behavior of their solutions. Topics may include dynamical systems, asymptotics, perturbation methods, variational methods, numerical methods and scientific computing. Prerequisites: MATH 212 and MATH 308 or permission of the instructor. Crosslisted as MATH 616.

MATH 446. Abstract Algebra II. 1 Credit.

Offered Alternate Fall or Spring; Lecture hours:3

Continuation of MATH 320. Advanced topics in group theory including solvable groups, field theory and Galois theory. Prerequisite: MATH 320.

MATH 491. Reading and Research. .5-2 Credits.

Offered Either Fall or Spring; Lecture hours:Varies; Repeatable

Reading and research in various topics for qualified undergraduates or graduate students at a level appropriate for a Culminating Experience. Prerequisite: permission of the instructor, adviser, and department chair.