

MATHEMATICS (MATH)

Courses

MATH 117 - Fundamentals of Mathematics for Elementary Teachers I Credits 3

This course will review and introduce standard and alternative algorithms in the following Common Core Domains: Operations Algebraic Thinking and Number Operations (Base 10 and Fractions). The use of manipulatives and math models are essential to the course. All eight Standards for Mathematical Practice will be explored and reinforced throughout the course. Core Curriculum: Approved for Core - Mathematics. **Note(s):** Cannot be counted toward the Mathematics major; typically offered in Fall. **Grade Mode:** A.

Restriction(s): Must be Liberal Stds Multidisciplinary (LSMD), Liberal Studies Elementary Ed (LSEE), Interdisciplinary Education (INED), or Early Childhood (LECD); and Undergraduate Level.

MATH 118 - Fundamentals of Mathematics for Elementary Teachers II Credits 3

Introductory geometry, congruence, symmetry, measurement, algebra and coordinate geometry, statistics, probability. Use of manipulatives. **Note(s):** Cannot be counted toward the Mathematics major; typically offered in Spring. **Grade Mode:** A.

Prerequisite(s): MATH 117.

Restriction(s): Must be Liberal Stds Multidisciplinary (LSMD), Liberal Studies Elementary Ed (LSEE), or Interdisciplinary Education (INED); and Undergraduate Level.

MATH 120 - The Nature of Mathematics Credits 3

Selected topics in mathematics with consideration of historical development and related philosophical issues. Designed to meet the Core Curriculum requirement in mathematics for liberal arts students. Core Curriculum: Approved for Core - Mathematics. **Note(s):** May not be counted toward the Mathematics major; credit given for either MATH 120 or MATH 130, not both. **Grade Mode:** A.

Restriction(s): Must not be Mathematical Science (MASC); and must be Undergraduate Level.

MATH 121 - QR: Real-World Math Modeling Credit 1

Quantitative Reasoning (QR) is using the math you already know to better understand the world. This course will cover important mathematical ideas and problem-solving skills in the context of the natural sciences such as biology, chemistry, physics, and environmental science. Topics may include ratios, rates, percentages, units, linear and exponential modeling. Conceptual understanding and application will be emphasized. Use of Excel software. Core Curriculum: Approved for Core - Mathematics. **Note(s):** Designed to be taken before MATH 123. **Grade Mode:** A.

Restriction(s): Must be Undergraduate Level.

MATH 122 - QR: Real-World Statistics Credit 1

Quantitative Reasoning (QR) is using the math you already know to better understand the world. This course will cover important mathematical ideas and problem-solving skills in the context of the behavioral sciences, the natural sciences, business, and beyond. Topics may include descriptive statistics, correlation, and probability. Conceptual understanding and application will be emphasized. Use of Excel software. Core Curriculum: Approved for Core - Mathematics. **Note(s):** Designed to be taken before MATH 123. **Grade Mode:** A.

Restriction(s): Must be Undergraduate Level.

MATH 123 - Quantitative Reasoning Topics in the Disciplines Credit 1
Special topics in quantitative reasoning. A culmination of Quantitative Reasoning (QR) skills and practices throughout the Core, this course uses discipline-specific topics and contexts for application, analysis, discussion, and written communication. Students will analyze data and arguments in specific fields. Conceptual understanding and application will be emphasized. Core Curriculum: Approved for Core - Mathematics. **Note(s):** Designed to be taken after MATH 121 and/or MATH 122; may be taken multiple times for credit. **Grade Mode:** A.

Restriction(s): Must be Undergraduate Level.

Repeat Limit (total number of credits): 3.

MATH 124 - Quantitative Reasoning for the Real World Credits 3

QR is using the math you already know to better understand the world. This course will cover important mathematical ideas and problem-solving skills in the context of the natural sciences, the behavioral sciences, real-world scenarios, and students' chosen fields of study. Topics may include: ratios, rates, percentages, units, descriptive statistics, linear and exponential modeling, correlation, logic, probability. Conceptual understanding and application will be emphasized. Core Curriculum: Approved for Core - Mathematics. **Grade Mode:** A.

Restriction(s): Must be Undergraduate Level.

MATH 125 - Precalculus Mathematics Credits 3

Sets, the real number system, relations, functions, graphs, algebraic processes, inequalities, trigonometric functions, exponential and logarithmic functions, and introduction to sequences. Core Curriculum: Approved for Core - Mathematics. **Note(s):** This is a rigorous math class recommended only for students pursuing advanced studies in calculus; may not be counted toward the major; three years of high school mathematics strongly recommended. **Grade Mode:** A.

Restriction(s): Must be Undergraduate Level.

MATH 140 - Fundamentals of Calculus Credits 3

Fundamental principles of differential and integral calculus. Applications chosen from diverse disciplines, such as business, economics, computer science, biology, and medicine. Core Curriculum: Approved for Core - Mathematics. **Grade Mode:** A.

Restriction(s): Must be Undergraduate Level.

MATH 150 - Calculus I Credits 4

Limits, differentiation and integration of rational and trigonometric functions, with applications. Core Curriculum: Approved for Core - Mathematics. **Note(s):** Four years of high school mathematics strongly recommended. **Grade Mode:** A.

Restriction(s): Must be Undergraduate Level.

MATH 151 - Calculus II Credits 4

Differentiation and integration of logarithmic, exponential and inverse trigonometric functions; various methods of integration; infinite sequences and series; parametric equations, polar coordinates. **Grade Mode:** A.

Prerequisite(s): MATH 150.

Restriction(s): Must be Undergraduate Level.

- MATH 180 - Topics in Mathematics** Credits 1-3
Topics in mathematics selected from Core Curriculum mathematics classes. Various topics to prepare and/or concurrently support students with specific content to aid in their academic success in Core math classes. May be arranged in conjunction with the individual needs of the student as well. Core Curriculum: Approved for Core - Mathematics. **Note(s):** May be taken multiple times for credit. **Grade Mode:** A.
Restriction(s): Must be Undergraduate Level.
Repeat Limit (total number of credits): 6.
- MATH 190 - Business Statistics** Credits 3
Collection and presentation of business data, central tendency and dispersion measures for business analysis, sampling and inference for confidence intervals and hypothesis testing, business forecasting with simple regression. Core Curriculum: Approved for Core - Mathematics. **Note(s):** Credit given for only one of MATH 190, MATH 210, or MATH 318. **Grade Mode:** A.
Restriction(s): Must be Accounting (ACCT), Business Administration (BUSN), Business Management (BMNG), Communication (COMU), Journalism and Integrated Media (JOIM), Organizational Leadership (BUOL), Public Relations (PBRE), Applied Statistics and Data Science Minor (MAAS), Actuarial Science concentration (MACT), or Global Marketplace concentration (SPGM); and Undergraduate Level.
- MATH 203 - Discrete Structures** Credits 3
Elementary properties of sets, discrete probability and combinatorial analysis, graphs, relations, orderings, functions, simple algebraic structures, binary arithmetic and other bases, methods of proof. **Note(s):** Completion of three years of high school mathematics strongly recommended. **Grade Mode:** A.
Restriction(s): Must be Undergraduate Level.
- MATH 204 - Introduction to Abstract Math** Credits 3
Set theory, Cartesian products, equivalence relations, images and inverse images, induction, recursions, inequalities, and field axioms. Emphasis on how to discover, write and present proofs. **Grade Mode:** A.
Prerequisite(s): MATH 150.
Restriction(s): Must be Undergraduate Level.
- MATH 210 - Introduction to Probability and Statistics** Credits 3
Nature of statistical methods, description of sample data, fundamental concepts of probability, probability distributions, sampling, estimation, correlation and regression, application of same. Core Curriculum: Approved for Core - Mathematics. **Note(s):** Credit given for only one of MATH 190, MATH 210, or MATH 318. **Grade Mode:** A.
Restriction(s): Must be Undergraduate Level.
- MATH 250 - Calculus III** Credits 4
Functions of two and three variables, partial differentiation, multiple integration, curves and surfaces in three dimensional space. **Grade Mode:** A.
Prerequisite(s): MATH 151.
Restriction(s): Must be Undergraduate Level.
- MATH 291 - Linear Algebra** Credits 3
Topics from matrices, determinants, linear transformations and vector spaces. **Grade Mode:** A.
Prerequisite(s): MATH 151.
Restriction(s): Must be Undergraduate Level.
- MATH 305 - Introduction to Real Analysis I** Credits 3
The real number system, elementary topological concepts in Cartesian spaces, convergence, continuity, derivatives and integrals. **Note(s):** Offered in alternate years. **Grade Mode:** A.
Prerequisite(s): MATH 204, MATH 250.
Restriction(s): Must be Undergraduate Level.
- MATH 315 - Abstract Algebra I** Credits 3
Introduction to abstract algebra with topics from elementary ring, field and group theories. Emphasis on ring of integers, congruences, polynomial domains, permutation groups. **Note(s):** Offered in alternate years. **Grade Mode:** A.
Prerequisite(s): MATH 204, MATH 291.
Restriction(s): Must be Undergraduate Level.
- MATH 318 - Biostatistics** Credits 3
Prepares the student for biostatistical application essential to practice in evidence-based professions. Content includes: descriptive statistics; probability theory and rules; discrete and continuous probability distributions; sampling distributions; confidence intervals; hypothesis testing; experimental design; ANOVA; linear and multiple regression; contingency table analysis; non-parametrics. Core Curriculum: Approved for Core - Mathematics. **Note(s):** Credit given for only one of MATH 190, MATH 210, or MATH 318. **Grade Mode:** A.
Restriction(s): Must be Undergraduate Level.
- MATH 319 - Statistics II** Credits 3
A second course in statistics; covers statistical analysis in greater depth. Topics will generally include multiple regression, time series analysis, designing observational and experimental studies, data science, and ethics. Final set of topics is subject to variation due to class interest. **Grade Mode:** A.
Prerequisite(s): MATH 190, MATH 210, MATH 318, AP Statistics, or equivalent with Department consent.
Restriction(s): Must be Undergraduate Level.
- MATH 320 - Probability and Statistics for Engineers and Scientists** Credits 3
Tabular and graphical methods for data summary using statistical software; sample spaces and probability; discrete and continuous random variables, probability distributions, and expected values; selected topics in multivariate distributions; introduction to stochastic processes; elements of statistical inference: hypothesis testing and estimation; and linear regression. **Grade Mode:** A.
Prerequisite(s): MATH 151.
Restriction(s): Must be Engineering (ENGR) or Robotics (ROBO); and Undergraduate Level.
- MATH 321 - Numerical Analysis** Credits 3
Functions of one variable, approximate numerical solutions of non-linear equations and systems of linear equations, interpolation theory, numerical differentiation and integration, and numerical solutions of ordinary differential equations. **Note(s):** Offered in alternate years. **Grade Mode:** A.
Prerequisite(s): MATH 291 or MATH 334; CSCI 105.
Restriction(s): Must be Undergraduate Level.
- MATH 326 - Mathematics CSET Preparation** Credit 1
Review of the subject matter of the Subtests of the CSET Mathematics exam. Test-taking strategies. **Note(s):** May be taken multiple times for credit. Does not count toward the major. **Grade Mode:** A.
Restriction(s): Must be Undergraduate Level.
Repeat Limit (after first attempt): 10.

- MATH 331 - Probability** **Credits 3**
 Samples spaces, axioms and elementary theorems of probability, combinatorics, independence, conditional probability, Bayes' Theorem, one and higher dimensional random variables, special and multivariate distributions. **Note(s):** Offered in alternate years. **Grade Mode: A.**
Prerequisite(s): MATH 204, MATH 250.
Restriction(s): Must be Undergraduate Level.
- MATH 332 - Mathematical Statistics** **Credits 3**
 Estimation: consistency, unbiasedness, maximum likelihood, confidence intervals. Hypothesis-testing: type I and II errors, likelihood ratio tests, test for means and variances; regression and correlation, Chi-square tests, decision theory, nonparametric statistics; application of statistical methods. **Note(s):** Offered in alternate years. **Grade Mode: A.**
Prerequisite(s): MATH 331.
Restriction(s): Must be Undergraduate Level.
- MATH 333 - Operations Research** **Credits 3**
 Operations Research is a formal mathematical science with wide applications to areas such as machine learning, economic mechanism design, supply chain management, decision science, and industrial engineering. This course covers mathematical foundations and computational frameworks for modeling, analysis, and optimal decision-making regarding various topics of business/industrial operations. Topics may include linear and nonlinear programming for optimization, game theoretic models for multi-agent interaction, Markov decision processes, or computational decision analysis. **Grade Mode: A.**
Prerequisite(s): MATH 150, CSCI 105.
Restriction(s): Must be Undergraduate Level.
- MATH 334 - Linear Algebra and Differential Equations** **Credits 4**
 Matrices, systems of linear equations, vector spaces, linear transformations, eigenvalues, systems of linear differential equations, and Laplace transforms. **Grade Mode: A.**
Prerequisite(s): MATH 151.
Restriction(s): Must be Engineering (ENGR) or Robotics (ROBO); and Undergraduate Level.
- MATH 335 - Ordinary Differential Equations** **Credits 3**
 First order differential equations, second order linear differential equations, power series solutions, Laplace transforms, systems of first order linear equations. **Note(s):** Offered in Spring. **Grade Mode: A.**
Prerequisite(s): MATH 250.
Restriction(s): Must be Undergraduate Level.
- MATH 336 - Mathematical Methods in Physics** **Credits 3**
 This course covers a variety of advanced mathematical techniques essential to the solution of problems in the physical sciences and engineering. Topics include tensors, complex variables, contour integrals, solutions of partial differential equations, boundary-value problems, special functions (such as Bessel functions and Legendre functions), and Fourier series and Fourier and Laplace transforms. **Grade Mode: A.**
Prerequisite(s): MATH 334 or MATH 335.
Restriction(s): Must be Undergraduate Level.
- MATH 341 - Classical Geometry** **Credits 3**
 Theorems of Pythagoras, incenters, circumcenters, circles, Euler line, Fermat center. Compass constructions. Solid geometry. Spherical geometry of arcs. Coordinate geometry. **Note(s):** Offered in alternate years. **Grade Mode: A.**
Restriction(s): Must be Undergraduate Level.
- MATH 370 - Readings in Mathematics** **Credit 1**
 Reading of material in a special topic. Colloquium participation. Writing and oral presentation of a research paper. **Note(s):** May be taken multiple times for credit. **Grade Mode: A.**
Restriction(s): Must be Mathematics (MATH) or Mathematical Science (MASC); and Undergraduate Level.
Repeat Limit (after first attempt): 10.
- MATH 380 - Statistics and Data Science Consulting Practicum** **Credits 1-3**
 Practical experience of applying statistical methods to real-world statistical consulting problems. Initial meeting with client, converting problem to solvable form, conducting analysis, and presenting results to client. Attention given to 'soft' (consultant-client interaction, effective group work, presentation skills) and 'hard' (analysis use of statistical software) aspects of consulting process. **Note(s):** This course may be taken multiple times for up to a total of 9 credits. **Grade Mode: A.**
Prerequisite(s): MATH 190, MATH 210, MATH 318, or MATH 332.
Restriction(s): Must be Undergraduate Level.
Repeat Limit (total number of credits): 9.
- MATH 410 - Introduction to Real Analysis II** **Credits 3**
 Main theorems in integral calculus. Infinite series of numbers and functions. **Note(s):** Offered in alternate years. **Grade Mode: A.**
Prerequisite(s): MATH 305.
Restriction(s): Must be Undergraduate Level.
- MATH 415 - Number Theory and the History of Mathematics** **Credits 3**
 The history of mathematics from Euclid through the 19th century as seen by exploring developments in number theory including congruences, Diophantine equations, divisibility, theorems of Fermat and Wilson, primitive roots, indices, quadratic reciprocity and the distribution of prime numbers. **Note(s):** Offered in Fall, odd years. **Grade Mode: A.**
Prerequisite(s): MATH 204.
Restriction(s): Must be Undergraduate Level.
- MATH 440 - Complex Variables** **Credits 3**
 Complex variables, analytic functions, complex integral theorems, power series, conformal mappings. **Note(s):** Offered in alternate years. **Grade Mode: A.**
Prerequisite(s): MATH 250.
Restriction(s): Must be Undergraduate Level.
- MATH 450 - Abstract Algebra II** **Credits 3**
 Topics from groups, ring and fields. Galois theory. **Note(s):** Offered in alternate years. **Grade Mode: A.**
Prerequisite(s): MATH 315.
Restriction(s): Must be Undergraduate Level.

MATH 455 - Linear Algebra II **Credits 3**

A continuation of Linear Algebra focused on the interplay of algebra and geometry as well as mathematical theory and its applications. Topics include matrix decompositions, eigenvalues and spectral theory, vector and Hilbert spaces, norms and low-rank approximations. Applications to biology, computer science, economics, and statistics, including artificial learning and pattern recognition, principal component analysis, and stochastic systems. Course and laboratory work balanced between theory and application. Successful completion of this course will prepare students in developing proficiency toward the accomplishment of the course objectives and student learning outcomes. **Note(s):** Offered in alternate years. **Grade Mode:** A.

Prerequisite(s): MATH 291.

Restriction(s): Must be Undergraduate Level.

MATH 465 - Advanced Topics in Mathematics **Credits 1-3**

Special studies in mathematics at an upper-division level of content. Included are such topics as Linear Algebra II, Putnam Exam preparation, Topology I and II. Topics are dependent on student needs and interests and faculty availability. Course to be used as an upper-division elective for Math majors. **Note(s):** May be taken multiple times for credit. **Grade Mode:** A.

Restriction(s): Must be Junior Class, or Senior Class; and Undergraduate Level.

Repeat Limit (total number of credits): 12.

MATH 470 - Statistics and Data Science Capstone **Credits 1-3**

Practical experience of applying statistical methods to real-world statistical consulting problems. Initial meeting with client, converting problem to solvable form, conducting analysis, and presenting results to client. Attention given to 'soft' (consultant-client interaction, effective group work, presentation skills) and 'hard' (analysis, use of statistical software) aspects of consulting process. Formal culmination of statistics program. **Grade Mode:** A.

Prerequisite(s): All other statistics courses in the student's program which requires MATH 470, which may be taken concurrently.

Restriction(s): Must be Undergraduate Level.

MATH 480 - Internship **Credits 1-3**

Professionally supervised participation in pre-approved research or a project at an off-campus site. Documentation of the time spent and the activities performed as well as a written paper explaining the project are required. **Note(s):** Special approval required; involvement shall be counted on the basis of forty-five hours per credit; may be taken multiple times for credit; may involve participation in a Research Experience for Undergraduates (REU) if approved by the Department.

Grade Mode: A.

Restriction(s): Must be Undergraduate Level.

Repeat Limit (total number of credits): 6.

MATH 490 - Directed Research **Credits 1-3**

Theoretical or applied research under the supervision of mathematics faculty. Outcomes may include novel mathematical results, a research report or paper, or professional presentation. **Note(s):** Special approval required; may be taken multiple times for credit. **Grade Mode:** A.

Restriction(s): Must be Undergraduate Level.

Repeat Limit (total number of credits): 6.