# MATHEMATICS (MATH)

**MATH 100 | FUNDAMENTALS OF ALGEBRAIC REASONING**
**Units: 3 Repeatability: No**
The goal of this course is to develop fundamental algebra skills and mathematical intuition in order to prepare students for mathematics courses that satisfy the mathematical reasoning and quantitative reasoning core requirements at USD. Students will build mathematical intuition by modeling real life situations using mathematical tools. Students will develop skills for solving algebraic equations, simplifying expressions, and solving problems. Students will investigate linear, polynomial, and rational expressions through the lenses of verbal, graphical, numerical, and algebraic representations.

**MATH 110 | INVESTIGATIONS IN MATHEMATICS**
**Units: 3 Repeatability: No**
**Core Attributes: First Yr Integration (LC Only), Math reasng and prob solving**
Prerequisites: MATH 090 or Passing the appropriate departmental placement test within the previous year or Passing the appropriate departmental placement test within the previous year or Passing the appropriate departmental placement test within the previous year
Mathematics is much more than calculation; it is an imaginative and creative endeavor that studies all sorts of patterns and structures, many of which are beautiful, intriguing, and applicable to the real world. This course will explore some surprising and rewarding mathematical ideas in areas that could include games, fractals, ciphers, elections, finance, risk measurement, the nature of infinity, or others. Along the way, students may confront issues that challenge their intuition, gain sharper analytical reasoning skills, and experience mathematical questions that have remained unsolved for hundreds of years. This course does not serve as a prerequisite to MATH 120, MATH 130, MATH 150, or MATH 200.

**MATH 115 | COLLEGE ALGEBRA**
**Units: 3 Repeatability: No**
**Core Attributes: Math reasng and prob solving**
Prerequisites: MATH 090 with a minimum grade of C- or Passing the appropriate departmental placement test within the previous year or Passing the appropriate departmental placement test within the previous year or Passing the appropriate departmental placement test within the previous year
Review of exponents, equations, and inequalities; function notation, composition, and inverses; linear, quadratic, polynomial, exponential, and logarithmic functions and their graphs.

**MATH 118 | ESSENTIALS OF TRIGONOMETRY**
**Units: 1**
Definitions, solutions of right triangles, graphs, identities, and inverse trigonometric functions.

**MATH 120 | INTRODUCTION TO STATISTICS**
**Units: 3 Repeatability: No**
**Core Attributes: Quantitative reasoning comp**
Prerequisites: MATH 115 or MATH 130 or MATH 150
Probability as a mathematical system, random variables and their distributions, confidence intervals, hypothesis testing, and other topics in statistical inference.

**MATH 130 | SURVEY OF CALCULUS**
**Units: 3 Repeatability: No**
**Core Attributes: First Yr Integration (LC Only), Math reasng and prob solving**
Prerequisites: Passing the appropriate departmental placement test within the previous year or Passing the appropriate departmental placement test within the previous year or MATH 115 with a minimum grade of C-
A terminal mathematics course giving an introduction to the concepts and techniques of elementary differential and integral calculus. Note 1: This course is not equivalent to MATH 150, and does not serve as a prerequisite to MATH 151. Prereq: MATH 115 with a grade of C- or better, or pass Level 2 mathematics placement exam (2MTH or 3MTH).

**MATH 133 | BUSINESS CALCULUS**
**Units: 3 Repeatability: No**
**Core Attributes: Math reasng and prob solving**
Prerequisites: Passing the appropriate departmental placement test within the previous year or MATH 115 with a minimum grade of C-
This course provides an introduction to differential calculus in the context of business applications, and mathematical finance. Additional business applications of linear algebra as time allows. Students may not receive credit for both MATH 133 and MATH 130. This course is intended for students in the School of Business. This course should not be taken as a substitute for MATH 130 by non-business majors or students who are undecided on their major.

**MATH 150 | CALCULUS I**
**Units: 4 Repeatability: No**
**Core Attributes: First Yr Integration (LC Only), Math reasng and prob solving**
Prerequisites: MATH 115 with a minimum grade of C- or Passing the appropriate departmental placement test within the previous year
Fundamental notions of analytic geometry, differential and integral calculus with elementary applications; historical references.

**MATH 151 | CALCULUS II**
**Units: 4 Repeatability: No**
**Core Attributes: Math reasng and prob solving**
Prerequisites: MATH 150 with a minimum grade of C-
Continuation of Calculus I including integration, infinite series, differential equations, applications, and historical references.

**MATH 200 | MATHEMATICAL CONCEPTS FOR ELEMENTARY TEACHERS I**
**Units: 3 Repeatability: No**
Prerequisites: MATH 115 with a minimum grade of C- or MATH 130 with a minimum grade of C- or MATH 150 with a minimum grade of C-
Problem solving, sets, numeration systems, a development of the whole number system, geometric figures, and computers. Note: This course does not count toward either the major or minor in mathematics.

**MATH 250 | CALCULUS III**
**Units: 4**
Prerequisites: MATH 151 with a minimum grade of C-
Calculus of several variables, partial derivatives, multiple integration, elements of vector calculus, elements of differential equations, applications, and historical references.

**MATH 260 | FOUNDATIONS OF HIGHER MATHEMATICS**
**Units: 3 Repeatability: No**
**Core Attributes: Math reasng and prob solving**
Prerequisites: MATH 150
Mathematics is a creative endeavor based on reasoning, discovery and justification. In higher mathematics we explore, conjecture, and formally prove theorems about the behavior of abstract objects that model different aspects of reality. This course is an introduction and transition to the goals, tools, and subject matter of higher mathematics, including logic, the methods and structure of mathematical proof, mathematical induction, basic set theory, creative problem solving, and mathematical writing and communication. Students may not receive credit for taking both MATH 260 and MATH 262.

**MATH 262 | DISCRETE MATHEMATICS**
**Units: 3 Repeatability: No**
**Core Attributes: Math reasng and prob solving**
Prerequisites: MATH 150
This course introduces students to discrete mathematical structures, in contrast to the continuous ones studied in calculus. It also serves as a gateway to higher mathematics, which is a creative endeavor based on reasoning, discovery, and justification, using abstract objects to model different aspects of reality. Core topics of the course, which emphasize creative problem solving and algorithmic thinking, include sets and functions, graph theory, induction and recursion, and logic and proof, with additional topics selected from number theory, combinatorics and probability.

**MATH 294 | SPECIAL TOPICS IN MATHEMATICS**
**Units: 0.5-4 Repeatability: Yes (Repeatable if topic differs)**
Prerequisites: MATH 151 with a minimum grade of C-
Topics of special interest chosen by the instructor.

**MATH 299 | LOWER DIVISION INDEPENDENT STUDY IN MATHEMATICS**
**Units: 1-3 Repeatability: Yes (Can be repeated for Credit)**
Independent lower division study of mathematics under the supervision of a member of the mathematics faculty.

**MATH 300 | MATHEMATICAL CONCEPTS FOR ELEMENTARY TEACHERS II**
**Units: 3 Repeatability: No**
Prerequisites: MATH 200 with a minimum grade of C
Measurement concepts, development of the real number system, algebra, geometric mappings, probability, and statistics. Note: This course does not count toward either the major or minor in Mathematics.

**MATH 305 | SEMINAR IN TEACHING MATHEMATICS**
**Units: 2**
Senior seminar for single subject credential students in mathematics. Issues in mathematics education including: Contribution to mathematics by men and women of various ethnic, racial, and cultural groups; equity considerations in mathematics education; variations in how students learn mathematics; diverse methods of communication and assessment in mathematics; and practical aspects of teaching diverse students. Students will be required to do some tutoring in mathematics. This course does not count toward the minor in mathematics or toward the upper division mathematics electives of the mathematics major (even for the secondary education emphasis).

**MATH 310 | APPLIED MATHEMATICS FOR SCIENCE AND ENGINEERING I**
**Units: 3 Repeatability: No**
Prerequisites: MATH 151 with a minimum grade of C-
Matrix algebra, ordinary differential equations, and operational techniques. Students may not receive credit for both MATH 310 and MATH 330 (mutually exclusive).

**MATH 311 | APPLIED MATHEMATICS FOR SCIENCE AND ENGINEERING II**
**Units: 3-4 Repeatability: No**
Prerequisites: MATH 250 with a minimum grade of C- and MATH 310 with a minimum grade of C-
Boundary value problems, partial differential equations, Fourier methods, and introduction to complex analysis.

**MATH 315 | APPLIED PROBABILITY AND STATISTICS**
**Units: 3**
Prerequisites: MATH 250
Introduction to probability; discrete and continuous random variables; conditional and joint distributions and densities; functions of random variables; expectation and estimation; central limit theorem; introduction to statistics; introduction to random sequences and random processes.

**MATH 320 | LINEAR ALGEBRA**
**Units: 3 Repeatability: No**
Prerequisites: MATH 260 with a minimum grade of C- or MATH 262 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C-
Systems of linear equations, matrix algebra and operations, vector spaces of three or more dimensions, linear independence, inner product spaces, linear transformations and their matrices, determinants, eigenvalues and eigenvectors, and brief introduction to canonical forms.

**MATH 325 | HISTORY OF MATHEMATICS**
**Units: 3 Repeatability: No**
Prerequisites: MATH 250 and (MATH 260 or MATH 160 or MATH 222 or MATH 262)
Selected topics from the history of mathematics. The course includes a variety of writing assignments. Emphasis is on the history of mathematical ideas, rather than on personalities or social background.

**MATH 330 | ORDINARY DIFFERENTIAL EQUATIONS**
**Units: 3 Repeatability: No**
Prerequisites: MATH 250 with a minimum grade of C- and (MATH 260 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C- or MATH 262 with a minimum grade of C-)
Preliminary ideas, differential equations of the first and second order, linear equations with constant coefficients, operational techniques, simultaneous equations, series solutions, and applications.

**MATH 331 | PARTIAL DIFFERENTIAL EQUATIONS**
**Units: 3**
Prerequisites: MATH 330 with a minimum grade of C-
Preliminary notions, techniques for solving well-known partial differential equations of physics, orthogonal functions, and applications. Prereq: MATH 330 with a grade of C- or better.

**MATH 340 | NUMERICAL ANALYSIS I**
**Units: 3 Repeatability: No**
Prerequisites: MATH 151 with a minimum grade of C- and (MATH 260 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C- or MATH 262 with a minimum grade of C-) and COMP 110 with a minimum grade of C-
Approximate computations and round-off errors, Taylor expansions, numerical solution of equations and systems of equations, numerical integration, numerical solution of differential equations, interpolation, and problem solving on the computer.

**MATH 341 | NUMERICAL ANALYSIS II**
**Units: 3**
Prerequisites: MATH 250 with a minimum grade of C- and MATH 320 with a minimum grade of C- and MATH 330 with a minimum grade of C- (Can be taken Concurrently) and MATH 340 with a minimum grade of C-
Estimation of eigenvalues and eigenvectors of matrices; numerical solutions of differential equations, existence, and stability theory; and computer lab assignments. Prereq: MATH 250, 320, 330 (may be taken concurrently), and 340, all with a grade of C- or better. Cross-listed as COMP 341.

**MATH 350 | PROBABILITY**
**Units: 3 Repeatability: No**
Prerequisites: MATH 250 with a minimum grade of C- and (MATH 260 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C- or MATH 262 with a minimum grade of C-)
Probability axioms, conditional probability, discrete and continuous sample spaces, random variables and common distributions, jointly distributed random variables, and central limit theorem.

**MATH 351 | MATHEMATICAL STATISTICS**
**Units: 3**
Prerequisites: MATH 350 with a minimum grade of C-
Statistical models, estimation, hypothesis testing, optimality, linear models, analysis of discrete data, and nonparametric methods. Prereq: MATH 350 with a grade of C- or better.

**MATH 355 | COMBINATORICS**
**Units: 3 Repeatability: No**
Prerequisites: MATH 260 with a minimum grade of C- or MATH 262 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C-
Principles of enumeration, finite difference calculus, generating functions, finite difference equations, principle of Inclusion and Exclusion, introduction to the theory of combinatorial graphs, and applications to computer science.

**MATH 360 | REAL ANALYSIS**
**Units: 3 Repeatability: No**
**Core Attributes: Advanced writing competency**
Prerequisites: MATH 260 with a minimum grade of C- or MATH 262 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C-
Analysis is the study of the foundations of calculus, including formal definitions of limits and convergence, and careful proofs of basic facts about numbers and functions. This course is an introduction to analysis of functions of one real variable.

**MATH 361 | TOPICS IN ANALYSIS**
**Units: 3 Repeatability: No**
Prerequisites: MATH 360 with a minimum grade of C-
Analysis is the study of the foundations of calculus, including formal definitions of limits and convergence, and careful proofs of basic facts about numbers and functions. This course is a continuation of MATH 360.

**MATH 365 | COMPLEX FUNCTION THEORY**
**Units: 3 Repeatability: No**
Prerequisites: (MATH 260 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C- or MATH 262 with a minimum grade of C-) and MATH 250 with a minimum grade of C-
Analytic function theory; power series, analytic continuation, conformal mapping, and applications.

**MATH 370 | THEORY OF NUMBERS**
**Units: 3 Repeatability: No**
Prerequisites: (MATH 260 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C- or MATH 262 with a minimum grade of C-) and MATH 151 with a minimum grade of C-
Divisibility, Euclidean algorithm, fundamental theorem of arithmetic, congruences, Fermat's theorem, Euler's function, Chinese Remainder Theorem, Diophantine equations, primitive roots, quadratic residues, reciprocity law, and continued fractions.

**MATH 375 | ABSTRACT ALGEBRA**
**Units: 3 Repeatability: No**
Prerequisites: MATH 320 with a minimum grade of C-
Abstract algebra is the study of operations like addition and multiplication that act on objects other than numbers, such as vectors, matrices, polynomials, functions, transformations, and symmetries. This course is an introduction to the basic structures of abstract algebra: groups, rings, integral domains, division rings, fields, vector spaces, and algebras, and their applications to other branches of mathematics.

**MATH 380 | GEOMETRY**
**Units: 3 Repeatability: No**
Prerequisites: (MATH 260 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C- or MATH 262 with a minimum grade of C-) and MATH 250 with a minimum grade of C-
An introduction to an area of modern geometry. The specific topic will be chosen from the following: non-Euclidean geometry, differential geometry, projective geometry, or metric geometry, and historical references.

**MATH 385 | TOPOLOGY**
**Units: 3 Repeatability: No**
Prerequisites: (MATH 260 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C- or MATH 262 with a minimum grade of C-) and MATH 250 with a minimum grade of C-
Metric spaces, topologies, subspaces, continuity, separation axioms, compactness, and connectedness.

**MATH 388 | MATHEMATICAL LOGIC**
**Units: 3 Repeatability: No**
Prerequisites: (MATH 260 with a minimum grade of C- or MATH 160 with a minimum grade of C- or MATH 222 with a minimum grade of C- or MATH 262 with a minimum grade of C-) and MATH 151 with a minimum grade of C-
Abstract structure of logical arguments, theory of the propositional and predicate calculus, and selected topics in modern logic.

**MATH 395 | MATHEMATICAL PROBLEM SOLVING SEMINAR**
**Units: 1 Repeatability: Yes (Can be repeated for Credit)**
Prerequisites: MATH 151 with a minimum grade of C-
This course is intended for students who enjoy the challenge of mathematical problems. This course differs from other mathematics courses which are focused on the theory and applications of a single branch of mathematics. It emphasizes problem-solving techniques, creative thinking, and exposition of skills in different areas of mathematics such as algebra, calculus, geometry, and number theory. (May be taken twice for credit.).

**MATH 405 | ADVANCED PERSPECTIVE ON HIGH SCHOOL MATHEMATICS**
**Units: 3**
This course is a required course in the Mathematics Single Subject credential program. It provides a capstone experience for future mathematics high school teachers, in which they look at topics in high school mathematics from an advanced viewpoint. Connections between mathematics topics and between basic and more advanced mathematics will be emphasized. This course does not count toward the minor in mathematics or toward the upper division mathematics electives of the mathematics major (even for the secondary education emphasis).

**MATH 440 | MATHEMATICAL MODELING IN ECOLOGY**
**Units: 4 Repeatability: No**
**Core Attributes: Advanced Integration**
Prerequisites: (MATH 160 or MATH 222) and (MATH 310 or MATH 330)
An introduction to mathematical applications to ecology. In this integrative course, students will learn to describe ecological processes in mathematical terms and formulate different types of mathematical models relevant to ecology. In a weekly lab, students from MATH 440 and EOSC 440 will work together on integrative projects and computer programming applications to mathematical ecology. Students may not receive credit for taking both MATH 440 and EOSC 440. Students may not receive credit for taking both MATH 440 and MATH 445.

**MATH 444 | FORUM**
**Units: 3 Repeatability: No**
**Core Attributes: Advanced writing competency, Oral communication competency**
Prerequisites: MATH 320 and (MATH 325 or MATH 330 or MATH 331 or MATH 340 or MATH 341 or MATH 350 or MATH 351 or MATH 355 or MATH 360 or MATH 361 or MATH 365 or MATH 370 or MATH 375 or MATH 380 or MATH 385 or MATH 388 or MATH 445)
The goal of this capstone mathematics course is to improve the ability to communicate mathematics, both written and oral, to a general and technical audience. In the process, students are exposed to a broad range of topics from modern and classical mathematics, and increase their familiarity with the culture of mathematics. This course fulfills the upper division writing and oral communication requirements.

**MATH 445 | MATHEMATICAL MODELING**
**Units: 3**
Prerequisites: MATH 250 with a minimum grade of C- and MATH 320 with a minimum grade of C- and MATH 330 with a minimum grade of C-
The construction and analysis of mathematical models, simplifying assumptions and testing strategies; topics chosen by the instructor in dimensional analysis, discrete and continuous dynamical systems, stochastic models, linear systems, optimization models, statistical methods, and graph theory. Prereq: MATH 250 with a grade of C- or better, MATH 320 with a grade of C- or better and MATH 330 with a grade of C- or better.

**MATH 493 | MATH EDUCATION FIELD EXPERIENCE**
**Units: 1-3 Repeatability: No**
**Non-Core Attributes: Experiential**
The goal of this course is to provide students who are working towards a single subject credential in mathematics with a supervised field experience working with pre-college learners of mathematics. The students must not only work with students learning mathematics, they must also reflect on that experience. They will write a paper of at least five pages in length in which they reflect on their experience, including any lessons they have learned for their future as credentialed mathematics teachers. This course is only for students who are intending to become pre-college teachers of mathematics.

**MATH 494 | SPECIAL TOPICS IN MATHEMATICS**
**Units: 0.5-4 Repeatability: Yes (Repeatable if topic differs)**
Topics of special interest chosen by the instructor. May be repeated for credit with the consent of the instructor.

**MATH 496 | DIRECTED RESEARCH**
**Units: 1-3 Repeatability: Yes (Can be repeated for Credit)**
**Non-Core Attributes: Undergraduate Research**
Independent research directed by a faculty member.

**MATH 498 | INTERNSHIP**
**Units: 1-3 Repeatability: Yes (Can be repeated for Credit)**
**Non-Core Attributes: Experiential**
Practical experience in the application of mathematics. Students will be involved in projects conducted by businesses, agencies, and institutions. Enrollment is arranged on an individual basis according to the student's interest and background, and the availability of positions. A written report is required. Units may not normally be applied toward the major or minor in mathematics. MATH 498 may be repeated for a total of three units.

**MATH 499 | INDEPENDENT STUDY**
**Units: 1-3 Repeatability: Yes (Can be repeated for Credit)**
Student reading in selected special topics; student presentations. May be repeated for credit once with a different topic. Only six units of MATH 499 will count towards completion of the Mathematics major. Additional units of MATH 499 will only count as units towards graduation.