Mathematics

IN THE COLLEGE OF SCIENCES

OFFICE: Geology/Mathematics/Computer Science 413
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Faculty
Emeritus: Carlson, Deaton, Elwin, Garrison, Geveci, Grone, Hager, Hintzman, Hui, Lesley, Lutz, Marcus, McLeod, Nemirovsky, Nower, Pierce, Salamon, Saltz, Short, Smith, Sowder, J., Sowder, L., Thompson, Van de Wetering, Verzi (SDSU-IV), Whitman
Chair: O’Sullivan
Professors: Blomgren, Carretero, Castillo, Duruster, Interlando, Lobato, Mahaffy, O’Sullivan, Palacios, Ponomarenko, Rasmussen, Shen, S.
Associate Professors: Bowers, Gilles, Kirschvink, Nickerson, Shen, B., Zahner
Assistant Professors: Curtis, George, Hong, Luque, O’Neill, Pilgrim, Qin (SDSU-IV), Reinholz, Vaidya

Offered by the Department of Mathematics and Statistics
Master of Arts degree in mathematics.
Master of Science degree in applied mathematics.
Master of Arts degree in mathematics.
Offered by the Department of Mathematics and Statistics

The Mathematics major and emphases are impacted programs. To be admitted to the mathematics major or an emphasis, students must meet the following criteria:

A. Complete preparation for the major. Refer to the individual program for specific impaction criteria;
B. Complete a minimum of 60 transferable semester units;
C. Have a minimum cumulative GPA of 2.0.

To complete the major, students must fulfill the degree requirements for the major described in the catalog in effect at the time they are accepted into the major at SDSU (assuming continuous enrollment).

Major Academic Plans (MAPs)

Visit http://www.sdsu.edu/mymap for the recommended courses needed to fulfill your major requirements. The MAPs website was created to help students navigate the course requirements for their majors and to identify which General Education courses will also fulfill a major preparation course requirement.

Mathematics Major

With the B.A. Degree in Liberal Arts and Sciences
(Major Code: 17011) (SIMS Code: 776301)

All candidates for a degree in liberal arts and sciences must complete the graduation requirements listed in the section of this catalog on “Graduation Requirements.” No more than 48 units in mathematics and statistics courses can apply to the degree.

A minor is not required with this major.

Impacted Program. Complete with a grade of C (2.0) or better:
Mathematics 150, 151, 245, 252, 254, and Statistics 250. These courses cannot be taken for credit/no credit.

A minimum of 30 upper division units selected with the approval of the departmental adviser before starting upper division work to include Mathematics 320, 330, 337, 340, 524; one course selected from Mathematics 520, 530, 531, 537, 538, 541, 542, 543, Statistics 551B, and 12 units of electives. Students planning to take Mathematics 499 as an elective course must obtain approval from the program adviser.

Master Plan. A master plan of the courses taken to fulfill the major must be approved by the adviser and filed with the major department.
Mathematics Major
With the B.S. Degree in Applied Arts and Sciences
(Major Code: 17031)
All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on “Graduation Requirements.”

There are three emphases offered in this major: Applied Mathematics, Computational Science, and Science.

Emphasis in Applied Mathematics
(SIMS Code: 776313)
This emphasis is designed to train the student in those areas of mathematics which may be applied to formulate and solve problems in other disciplines. The program is designed to qualify the student for employment as an applied mathematician, but the graduate would also be well prepared for graduate study in pure or applied mathematics.
A minor is not required with this major.
Impact Program. Complete with a grade of C (2.0) or better: Mathematics 150, 151, 245, 252, 254, Statistics 250, and Computer Science 107. These courses cannot be taken for credit/no credit (Cr/NC). The cumulative GPA in Mathematics 245, 252, and 254 must be a C+ (2.3) or better.
Preparation for the Major. Mathematics 150, 151, 245, 252, 254, Statistics 250, and Computer Science 107. These courses must be completed with a grade of C (2.0) or better, and cannot be taken for credit/no credit (Cr/NC). The cumulative GPA in Mathematics 245, 252, and 254 must be a C+ (2.3) or better. (24 units)
Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.
Major. A minimum of 36 upper division units to include Mathematics 320, 330, 337, 340; 524 or 543; 530 or 531 or 532; Statistics 350A or 550 or 551A; and 15 units of electives in mathematics or an area to which mathematics may be applied (approved by the applied mathematics adviser) excluding Mathematics 302, 303, 312, 313, 342A, 342B, 413, 414, 509. Students planning to take Mathematics 499 as an elective course must obtain approval from the program adviser.
Master Plan. A master plan of the courses taken to fulfill the major must be approved by the adviser and filed with the major department.
Auxiliary Area. A minimum of 10 units (lower or upper division) from an area to which mathematics may be applied. A typical program might be Physics 195, 195L, 196, 196L, 197, 197L; or Chemistry 200, 201, and a course for which these are prerequisite; or Economics 101, 102, 320, 321. The intent is to train the student in an area in some depth. Some latitude may be allowed in the choice of department and mix of courses, but all programs must be approved by the Applied Mathematics adviser. The 10 unit requirement is minimal, and a minor in an approved field is highly recommended.

Emphasis in Computational Science
(SIMS Code: 776322)
A minor is not required with this major.
Impact Program. Complete with a grade of C (2.0) or better: Mathematics 150, 151, 245, 252, 254, Computer Science 107, 108, and Statistics 250. These courses cannot be taken for credit/no credit (Cr/NC). The cumulative GPA in Mathematics 245, 252, and 254 must be a C+ (2.3) or better.
Preparation for the Major. Mathematics 150, 151, 245, 252, 254, Computer Science 107, 108, and Statistics 250. These courses must be completed with a grade of C (2.0) or better, and cannot be taken for credit/no credit (Cr/NC). The cumulative GPA in Mathematics 245, 252, and 254 must be C+ (2.3) or better. (27 units)
Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.
Major. A minimum of 39 upper division units to include Mathematics 320, 330, 337, 340; 524 or 543; Computer Science 310; at least nine units selected from Computational Science 526, 536, Computer Science 503, 558, Mathematics 336, 525, 532, 537, 541, 542, 543; three units of Mathematics 499 (Senior Project – approved by the applied mathematics adviser); and nine units of electives in computer science, mathematics, or statistics (approved by the Applied Mathematics adviser) excluding Mathematics 302, 303, 312, 313, 342A, 342B, 413, 414, 509.
Master Plan. A master plan of the courses taken to fulfill the major must be approved by the adviser and filed with the major department.

Emphasis in Science
(SIMS Code: 776348)
This purpose of this emphasis is to allow students with a strong interest in the mathematical aspects of a particular science to apply courses in that science to their major. This will provide a good background for employment or graduate work in applied mathematics or in that science.
A minor is not required with this major.
Impact Program. Complete with a grade of C (2.0) or better: Mathematics 150, 151, 245, 252, 254, Statistics 250, and Computer Science 107. These courses cannot be taken for credit/no credit (Cr/NC). The cumulative GPA in Mathematics 245, 252, and 254 must be a C+ (2.3) or better. (24 units)
Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.
Major. A minimum of 36 upper division units to include Mathematics 330, 337, 340, 524 or 543; at least six units selected from Mathematics 320, 525, 530 or 532; Mathematics 330, 337, 340; 524 or 543; at least six units selected from Mathematics 320, 525; 530 or 532; Mathematics 330, 337, 340; 524 or 543; at least six units selected from Mathematics 320, 525; 530 or 532; Statistics 350A or 550 or 551A; and 15 units of electives in mathematics or an area to which mathematics may be applied (these should be from a single science and must be approved by the B.S. adviser); and six units of electives in computer science, mathematics, or statistics excluding Mathematics 302, 303, 312, 313, 342A, 342B, 413, 414, 509. Students planning to take Mathematics 499 as an elective course must obtain approval from the program adviser.
Master Plan. A master plan of the courses taken to fulfill the major must be approved by the adviser and filed with the major department.

Mathematics Major
In preparation for the Single Subject Teaching Credential With the B.A. Degree in Liberal Arts and Sciences
(Major Code: 17011) (SIMS Code: 776303)
All candidates for a teaching credential must complete all requirements as outlined in this section of the catalog under Dual Language and English Learner Education or Teacher Education. For students completing the single subject teaching credential program, no more than 48 units in mathematics and statistics courses can apply to the degree.
This major may be used by students preparing to be high school teachers as an undergraduate major for the B.A. degree in liberal arts and sciences.
A minor is not required with this major.
Impact Program. Complete with a grade of C (2.0) or better: Mathematics 150, 151, 245, 252, 254, Statistics 250, and Teacher Education 211A. These courses cannot be taken for credit/no credit (Cr/NC).
Preparation for the Major. Mathematics 150, 151, 245, 252, 254, Statistics 250, and Teacher Education 211A. These courses
must be completed with a grade of C (2.0) or better, and cannot be taken for credit/no credit (Cr/NC). (22 units) Recommended: Computer Science 107, Physics 195, 195L, 196, 196L, 197, 197L.

Language Requirement. Competency (successfully completing the third college semester or fifth college quarter) is required in one foreign language as part of the preparation for the major. Refer to the section of this catalog on “Graduation Requirements.”

Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.

Major. A minimum of 25 upper division units in mathematics to include Mathematics 302, 303, 320, 330, 341, 414, Statistics 550; an upper division course in geometry; and three units of electives in mathematics approved by the adviser for the major.

Master Plan. A master plan of the courses taken to fulfill the major must be approved by the adviser and filed with the major department.

Mathematics Minor
(Minor Code: 17011) (SIMS Code: 776301)

The minor in mathematics consists of a minimum of 20-21 units in mathematics to include 12 upper division units, at least six of which have as prerequisite Mathematics 151; or Mathematics 252 and nine upper division units in mathematics, at least six of which have as prerequisite Mathematics 151. The courses selected will be subject to the approval of the minor adviser.

Courses in the minor may not be counted toward the major, but may be used to satisfy preparation for the major and general education requirements, if applicable. A minimum of six upper division units must be completed in residence at San Diego State University.

Single Subject Mathematics Certificate
(SIMS Code: 776357)

The purpose of the Single Subject Mathematics Certificate program is to provide individuals appropriate mathematics coursework to establish their subject matter competency in accordance with California State requirements for high school mathematics teachers. Admission is open to individuals who are majoring or have majored in an area other than mathematics and who have the equivalent of two years of high school mathematics and satisfy the SDSU Mathematics/Quantitative Reasoning Assessment requirement. In order to enroll in the program, individuals should contact the single subject mathematics credential adviser in the Department of Mathematics and Statistics.

The program consists of 46 units to include Mathematics 150, 151; and 245, 252, 254, 302, 303, 341, 320, 330, 414, 510, Statistics 250, 550, and three units of upper division electives selected from mathematical or physical sciences.

Individuals must complete at least nine upper division units at San Diego State University and have a cumulative grade point average of 2.5 in the required courses to qualify for the certificate.

Mathematics Placement Assessment
All students who expect to enroll in Computer Science 100, 107, Mathematics 105, 118, 120, 124, 141, 150, 210, 211, Statistics 119, 250 must satisfy the SDSU Mathematics/Quantitative Reasoning Assessment requirement. For Mathematics 124, 141, and 150, students must also pass the Mathematics Placement Assessment. For Mathematics 150, certain prerequisite courses taken at San Diego State University may be used to satisfy the Mathematics Placement Assessment requirement. For Mathematics 312 and 313, students must pass the Liberal Studies Mathematics Proficiency Assessment.

Computer Science
(See this section of catalog under Computer Science)

Statistics
(See this section of catalog under Statistics)
MATH 210X. Number Systems in Elementary Mathematics
Support (1) Cr/NC
Prerequisite: Concurrent registration in Mathematics 210.
Three hours of activity.
Required for students who have not satisfied the SDSU Mathematics/Quantitative Reasoning Assessment requirement.
Required support course for Mathematics 210. Credit in this course satisfies the SDSU Mathematics/Quantitative Reasoning Assessment requirement.

MATH 211. Geometry in Elementary Mathematics (3) [GE]
Prerequisite: Mathematics 210.
Two and three dimensional shapes and interrelationships, congruence, similarity and proportional reasoning, measurement of length, angle size, area, volume, metric system, and problem solving.

MATH 245. Discrete Mathematics (3) [GE]
Prerequisite: Mathematics 124 or 150 with a grade of C (2.0) or better. Recommended: Mathematics 151.
Logic, methods of proof, set theory, number theory, equivalence and order relations, counting (combinations and permutations), solving recurrence relations.

MATH 252. Calculus III (4) [GE]
Prerequisite: Mathematics 151 with a grade of C (2.0) or better. Functions of several variables. Vectors. Partial derivatives and multiple integrals. Line integrals and Green's Theorem.

MATH 254. Introduction to Linear Algebra (3) [GE]
Prerequisite: Mathematics 151 or 245 with a grade of C (2.0) or better. Matrix algebra, Gaussian elimination, determinants, vector spaces, linear transformations, orthogonality, eigenvalues, and eigenvectors.

MATH 296. Experimental Topics (1-4)
Selected topics. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

MATH 299. Special Study (1-3)
Prerequisite: Consent of instructor.
Individual study. Maximum credit six units.

UPPER DIVISION COURSES
(Reserved for Undergraduates)
NOTE: Proof of completion of prerequisites required for all upper division courses: Copy of transcript.

MATH 302. Transition to Higher Mathematics (3)
Prerequisite: Mathematics 141 or 150.
Selected topics in mathematics to emphasize proof writing and problem solving. Intended for those planning to teach secondary school mathematics.

MATH 303. History of Mathematics (3) [GE]
Prerequisite: Mathematics 141 or completion of the General Education requirement in Foundations of Learning IIA., Natural Sciences and Quantitative Reasoning for nonmajors.
Major currents in the development of mathematics from ancient Egypt and Babylon to late nineteenth century Europe.

MATH 312. Topics from Elementary Mathematics: Statistics and Probability (3)
Prerequisites: Mathematics 211 and satisfactory performance on Liberal Studies Mathematics Proficiency Assessment.
Topics from statistics and probability. Enrollment limited to future teachers in grades K-8.

MATH 313. Topics in Elementary Mathematics: Algebra of Change (3)
Prerequisites: Mathematics 211 and satisfactory performance on Liberal Studies Mathematics Proficiency Assessment.
Capstone course for prospective K-8 teachers. Advanced topics in mathematics selected from algebra, number systems, transformation geometry, and problem solving. Enrollment limited to future teachers in grades K-8.

MATH 320. Abstract Algebra (3)
Prerequisites: Mathematics 245 and 254 with a grade of C (2.0) or better in each course. Proof of completion of prerequisites required. Copy of transcript.

MATH 330. Advanced Calculus I (3)
Prerequisites: Mathematics 245 and either 254 or 342A with a grade of C (2.0) or better in each course. Proof of completion of prerequisites required. Copy of transcript.

MATH 336. Introduction to Mathematical Modeling (3)
Prerequisite: Mathematics 254 with a grade of C (2.0) or better.
Models from the physical, natural, and social sciences including population models and arms race models. Emphasis on classes of models such as equilibrium models and compartment models.

MATH 337. Elementary Differential Equations (3)
Prerequisite: Mathematics 254 or 342A with a grade of C (2.0) or better.
Integration of first-order differential equations, initial and boundary value problems for second-order equations, series solutions and transform methods, regular singularities.

MATH 340. Programming in Mathematics (3)
Prerequisites: Mathematics 151 and 245 with a grade of C (2.0) or better in each course. Proof of completion of prerequisites required. Copy of transcript.
Introduction to programming in mathematics. Modeling, problem solving, visualization. Not open to students with credit in Mathematics 242.

MATH 341. Mathematics Software Workshop (1)
Two hours of activity.
Prerequisite: Mathematics 150.
Lesson plan design using teacher-based technologies. Formerly numbered Mathematics 241.

MATH 342A. Methods of Applied Mathematics I (3)
Prerequisite: Mathematics 252.

MATH 342B. Methods of Applied Mathematics II (3)
Prerequisite: Mathematics 342A with a grade of C (2.0) or better.
Mathematics

MATH 413. Mathematics for the Middle Grades (3)
Prerequisite: Mathematics 313.
Teacher-level look at mathematics taught in middle grades, to include proportional reasoning, rational and real numbers, probability, and algebra. Intended for those planning to teach mathematics in middle grades; cannot be used as part of major or minor in mathematical sciences with exception of major for single subject teaching credential. Students in the SSTC major must receive instructor permission.

MATH 414. Mathematics Curriculum and Instruction (3)
Prerequisites: Senior standing and 12 upper division units in mathematics.
Historical development of mathematics and mathematics curriculum. Principles and procedures of mathematics instruction in secondary schools. For secondary and postsecondary teachers and teacher candidates. Course cannot be used as part of the major or minor in mathematical sciences with exception of major for the single subject teaching credential.

MATH 496. Experimental Topics (1-4)
Selected topics. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

MATH 499. Special Study (1-3)
Prerequisite: Consent of instructor.
Individual study. Maximum credit six units.

UPPER DIVISION COURSES
(Also Acceptable for Advanced Degrees)

MATH 508. Dynamical Systems and Modeling (3)
Prerequisite: Mathematics 254 or graduate standing.
Differential equations using analytical, graphical, and numerical representations.

MATH 509. Computers in Teaching Mathematics (3)
Two lectures and three hours of laboratory.
Prerequisite: Mathematics 252 with a grade of C (2.0) or better.
Proof of completion of prerequisite required: Copy of transcript.
Solving mathematical tasks using an appropriate computer interface, and problem-based curricula. Intended for those interested in mathematics teaching.

MATH 510. Introduction to the Foundations of Geometry (3)
Prerequisite: Mathematics 151 with a grade of C (2.0) or better.
Proof of completion of prerequisite required: Copy of transcript.
The foundations of Euclidean and hyperbolic geometries. Highly recommended for all prospective teachers of high school geometry.

MATH 520. Algebraic Structures (3)
Prerequisite: Mathematics 320 with a grade of C (2.0) or better or graduate standing.
Proof of completion of prerequisite required: Copy of transcript.
Continuation of Mathematics 320. Group theory to include finite Abelian groups, group homomorphisms and isomorphisms, normal subgroups, quotient groups, and Sylow theorems. Selected advanced topics to include field extensions or integral domains. (Formerly numbered Mathematics 521B.)

MATH 522. Number Theory (3)
Prerequisite: Mathematics 245 with a grade of C (2.0) or better.
Proof of completion of prerequisite required: Copy of transcript.
The theory of numbers to include congruences, Diophantine equations, and a study of prime numbers; cryptography.

MATH 523. Mathematical Logic (3)
Prerequisite: Mathematics 245 with a grade of C (2.0) or better.
Proof of completion of prerequisite required: Copy of transcript.
Propositional logic and predicate calculus. Rules of proof and models. Completeness and the undecidability of arithmetic. Not open to students with credit in Philosophy 521.

MATH 524. Linear Algebra (3)
Prerequisites: Mathematics 245 and either 254 or 342A with a grade of C (2.0) or better in each course.
Proof of completion of prerequisites required: Copy of transcript.
Vector spaces, linear transformations, orthogonality, eigenvalues and eigenvectors, normal forms for complex matrices, positive definite matrices and congruence.
Mathematics Education

Courses (MTHED AND MATH)

Refer to Courses and Curricula and University Policies sections of this catalog for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.

LOWER DIVISION COURSE IN MATHEMATICS EDUCATION (MTHED)

(Intended for Undergraduates)

MATH 501A. Reasoning: Place Value and Arithmetic Operations (1)
Prerequisites: Teaching credential and consent of instructor. Place value and its role in development and understanding of arithmetic operations, to include numeration systems, student methods, standard algorithms, and mental computation.

MATH 501B. Reasoning: Rational Numbers and Real Number Systems (1)
Prerequisites: Teaching credential and consent of instructor. Rational numbers and structure of real number system, to include meanings and models for fractions with attention to operations on rational numbers.

MATH 502A. Reasoning: Quantities and Mathematical Relationships (1)
Prerequisites: Teaching credential and consent of instructor. Reasoning about measurable characteristics in problem context, and relationships among these measurements. Additive, multiplicative reasoning, and proportional reasoning in middle grades.

GRADUATE COURSES

Refer to the Graduate Bulletin.