



Please Note:
*Highlighting indicates substantive updates for
 the 2009/2010 academic year.*

Updates are effective July 1, 2009.

Faculty

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Degrees and Programs

Mathematics, B.S.....	135
Teaching Credential.....	136

The MATHEMATICS DEPARTMENT provides courses for future mathematicians, teacher education, general education, and programs in other departments. A common goal of each course is that students will develop problem-solving skills based on mathematical reasoning and understanding, not merely rote memorization.

Students majoring in mathematics will have experience with mathematical modeling, abstraction generalization, logical analysis, and mathematical technology. Small class sizes promote communication and teamwork opportunities among students and faculty.

A focus on pure mathematics can lead to careers in university teaching and research following graduate studies in mathematics and related areas, such as statistics, computer science, and physics. A focus on applied mathematics is a path to careers in medicine, government, business, and industry following graduate study in such areas as computational biology, operations research, and applied statistics. A focus on mathematics education is a major component in a program of studies leading to the California Teaching Credential in secondary school mathematics. Actuarial certification can lead to careers in the insurance and investment industry, where actuaries use a broad knowledge of statistics, finance, and business.

Major in Mathematics, B.S.

A minimum of 67 hours (30 upper-division hours)

► Required Core Courses (42 hours):

MATH 131-132-133	Calculus I-II-III	4-4-4
MATH 265	Elementary Linear Algebra	4
MATH 269	Elementary Differential Equations	4
MATH 275	Logic and Sets	4
MATH 331	Probability Theory	3
MATH 351	Introduction to Abstract Algebra I	3
MATH 385	Mathematical Modeling	4
MATH 390	Seminar	1
MATH 421	Elementary Real Analysis I	3
MATH 490	Senior Seminar	1

At least one of the following courses:

MATH 332	Mathematical Statistics (3)	3
MATH 342	Geometries II (3)*	3
MATH 352	Introduction to Abstract Algebra II (3)	3
MATH 422	Elementary Real Analysis II (3)	3

► Required Core Electives (18 hours):

At least 12 hours from the following:	12
Additional upper-division MATH courses	

At least 6 hours from the following:	6
Additional MATH courses	

► Required Cognate Courses (7-9 hours):

CPTR 115	Introduction to Computer Programming	4
At least one of the following courses:	3-5	
CHEM 451	Physical Chemistry (3)	3
CPTR 132	Data Structures and Algorithms I (4)	4
CPTR 347	Database Systems (4)	4
CPTR 437	Computer Graphics (3)	3
CPTR 455	Theory of Computation (3)	3

* Students who select this option must also complete MATH 341: Geometries I as an upper-division core elective.

Mathematics

ENGR 211	Engineering Mechanics (3)
ENGR 216	Circuit Theory (4)
FIN 341	Finance (5)
INFS 470	Management Science (4)
PHYS 211	Physics with Calculus (4)
STAT 322	Statistical Methods (3)

All core and cognate courses should be chosen in consultation with the major advisor. In selecting courses, students are encouraged to consider the recommendations described below:

Pure Mathematics

The following courses are recommended for students interested in pure mathematics: MATH 267, MATH 332, MATH 352, MATH 422, MATH 425, and MATH 465.

Applied Mathematics

The following courses are recommended for students interested in applied mathematics: MATH 332, MATH 355, MATH 375, STAT 322, INFS 470.

It is also recommended that students interested in applied mathematics earn at least a minor in an applied field such as Biology, Business Administration, Computer Science, Physics, or Psychology.

Mathematics Education

The following courses are recommended for students interested in mathematics education: MATH 341, MATH 342, MATH 354, MATH 355, and MATH 451.

Actuarial Certification

The following courses are recommended for students interested in preparing for the national examinations for actuarial certification: MATH 267, MATH 322, MATH 375, STAT 322, and INFS 470.

Teaching Credential

Students desiring to enter a program of studies leading to a California teaching credential in mathematics should take the B.S. degree in Mathematics and complete the recommended courses for the Mathematics Education focus. Students will need to pass the mathematics portion of the CSET exam one quarter prior to doing full-time student teaching. Students are invited to discuss the program with their major advisor in the Mathematics Department.

Those who plan to teach on the secondary level should consult with the credential analyst in the Education Department and should become acquainted with the specific requirements for admission to and successful completion of the Teacher Education Program as outlined in the section entitled "Education" in this catalog.

Minor in Mathematics

A minimum of 30 hours (6 upper-division hours)

► *Required Courses (16 hours):*

MATH 131-132-133	Calculus I-II-III	4-4-4
MATH 275	Logic and Sets	4

► *Required Electives (14 hours):*

<i>At least 6 hours from the following:</i>	6
Additional upper-division MATH courses	
<i>At least 8 hours from the following:</i>	8
Additional MATH courses	

The following elective courses are especially recommended for students interested in secondary-level teaching: MATH 265, MATH 341, MATH 342, and MATH 351.

The following elective courses are especially recommended for students interested in engineering or a physical science: MATH 265, MATH 267, and MATH 269.

Mathematics

SERVICE COURSES:

(Not applicable to a major or minor in this department)

MATH 019 **4 F, W**
Introductory Algebra

Basic concepts and techniques of algebra for students without recent experience in algebra. Integers, algebraic expressions, first-degree equations, simple rational expressions and proportions, integer exponents, scientific notation, polynomials and factoring, solving equations by factoring, graphing, and systems of linear equations.

MATH 096 **4 F, W, S**
Intermediate Algebra

Factoring, linear and quadratic equations, linear inequalities, functions, graphs, rational expressions, rational exponents and radicals, equations involving rational and radical expressions, complex numbers, and systems of equations. Prerequisite: MATH 019 or equivalent.

MATH 106 **4 F, S**
College Algebra

Begins with a quick review of intermediate algebra, including rational exponents and radicals, complex numbers, linear and quadratic equations, and inequalities. Also includes polynomial and rational functions, binomial theorem, composition and inverse of functions, exponentials and logarithms, systems of equations, arithmetic and geometric progressions. Other topics may include further study of polynomials and/or linear programming. Prerequisite: Algebra II in high school or MATH 096.

MATH 120 **2 S**
Trigonometry

A study of the six trigonometric functions and their relationships to one another, as well as the study of applications involving these six functions. Included are degree and radian measure, right triangle trigonometry, graphs of the trigonometric functions, inverse trigonometric functions, fundamental identities, addition identities, double-angle and half-angle identities, solutions of trigonometric equations, law of cosines, law of sines, and vector triangles. Prerequisite: MATH 106 or a strong background in algebra.

MATH 130 **5 F**
Precalculus

Functions and graphs emphasized as tools to prepare the student for calculus. Included are polynomial and rational functions, logarithmic and exponential functions, as well as a thorough treatment of the six trigonometric functions and their inverses. Prerequisite: MATH 106 or a strong background in algebra.

MATH 211-212 **3-3 F-W**
Foundations of School Mathematics I-II

The logic and structure underlying school mathematics. Concepts, procedures, problem-solving and applications at concrete, pictorial, and abstract levels.

MATH 211 includes problem-solving techniques, sets, logic and deductive reasoning, the arithmetic of whole numbers, fractions, decimals, integers, rational and real numbers, ratio and proportion, and percent. Prerequisite: Algebra II in high school or MATH 096.

MATH 212 includes geometry and measurement. Prerequisite: MATH 211.

LOWER-DIVISION COURSES:

MATH 131-132-133 **4-4-4 F-W-S**
Calculus I-II-III

MATH 131: Introduction to the techniques of differentiation and integration. Includes the chain rule, fundamental theorem and maximizing/minimizing applications. Graphing calculators and mathematical software tools are used extensively. Prerequisite: MATH 106 and MATH 120, or MATH 130, or a strong background in algebra and trigonometry.

MATH 132: Further skills in integration and its applications. Includes general substitutions, integration by parts, applications to geometry and physics, infinite series, and Taylor expansions. Prerequisite: MATH 131.

MATH 133: Includes special curves, parametrizations, polar coordinates, solid analytic geometry, partial derivatives, and multiple integrals. Prerequisite: MATH 132.

MATH 265 **4 F**
Elementary Linear Algebra

Matrix algebra and determinants, applications to solving systems of linear equations, vector spaces, linear transformations, eigenvalues, and eigenvectors. Prerequisite: MATH 131.

MATH 267 **4 W**
Vector Calculus

Functions of more than one variable including the general chain rule, line and surface integrals, divergence, curl, gradient, and Stokes' theorem. Prerequisite: MATH 133.

Mathematics

MATH 269 **4 S** **Elementary Differential Equations**

Ordinary differential equations balancing analytic techniques, qualitative methods, and basic modeling. Topics include eigenvalue methods for linear systems, Laplace transforms, phase plane, null-clines, equilibria, harmonic oscillator, and population models. Prerequisites: MATH 132, 265.

MATH 275 **4 S** **Logic and Sets**

A bridge to upper-division mathematics, developing the student's ability to handle abstract concepts and careful proofs. Propositional and predicate logic, various types of proof, algebra of sets and functions, equivalence relations, and countable sets. Prerequisite: MATH 131. UPPER-DIVISION COURSES:

MATH 331 **3 W** **Probability Theory**

Theory and applications of probability theory. Probability distributions and densities including multivariate, marginal, and conditional distributions. Expected value, Chebyshev's and Bayes' theorems. Moment-generating functions and product moments. Special discrete and continuous distributions and densities. Prerequisites: CPTR 115, MATH 133, 275, STAT 222. Odd years.

MATH 332 **3 S** **Mathematical Statistics**

Theory and application of sampling distributions, transformation of variables, central limit theory, estimation, hypothesis testing, Bayesian inference, and decision theory. Prerequisites: MATH 331. Odd years.

MATH 341-342 **3-3 W-S** **Geometries I-II**

A two-quarter study of the development and history of Euclidean geometry, the discovery of non-Euclidean geometry and the subsequent reformulation of the foundations of geometry.

MATH 341 reviews basic Euclidean geometry, introduces non-Euclidean geometries, and investigates geometric applications through problems and projects.

MATH 342 focuses on the axiomatic method, logic, various axiom sets for Euclidean geometry, neutral geometry, history of the parallel postulate, discovery of non-Euclidean geometry, hyperbolic geometry, and philosophical implications.

Prerequisites: MATH 275 or permission of the instructor. Even years.

MATH 351-352 **3-3 F-W** **Introduction to Abstract Algebra I-II**

MATH 351 is a basic introduction to groups, rings, integral domains, fields, and isomorphisms. Also included are mappings, equivalence relations, and modular arithmetic. MATH 352 is a continuation of MATH 351 that stresses applications. Topics studied include polynomials, elementary Galois theory, geometric constructions, algebraic coding, lattices, and Boolean algebras. Prerequisite: MATH 275. Odd years.

MATH 354 **3 S** **Number Theory**

Topics include Diophantine equations, theorems and conjectures about prime numbers, congruences, the theorems of Euler and Fermat, perfect numbers, continued fractions, and Pythagorean triples. Prerequisite: MATH 275. Odd years.

MATH 355 **4 F** **Combinatorics and Graph Theory**

Permutations and combinations, occupancy models, generating functions, recurrence relations, principle of inclusion and exclusion, and pigeonhole principle. Graph Theory includes directed and undirected graphs, Euler and Hamiltonian paths, chromatic number, trees, matchings and coverings. Involves both theory and applications. Prerequisite: MATH 275. Even years.

MATH 375 **4 W** **Numerical Analysis**

Theory and techniques for finding approximate solutions to mathematical problems, including error analysis, interpolation, approximation, fixed-point iteration, nonlinear equations, systems of equations, integration, and ordinary differential equations. Prerequisites: MATH 132, 265, and CPTR 115. Even years.

MATH 385 **4 F** **Mathematical Modeling**

Mathematical modeling of problems selected from a variety of applied areas, including industry, biology, business, and the social sciences. Both deterministic and stochastic models are considered, with an emphasis on practical problem-solving. Includes exploration of the computer as a problem-solving tool. Prerequisite: MATH 269 and CPTR 115 or permission of the instructor. Odd years.

MATH 390 **1 S**
Seminar

Topics of current interest in mathematics and mathematics education, including applications of mathematics in other fields, introduced through lectures, reports, and periodicals. Discussion of professional mathematics organizations, conferences, and publications. Prerequisite: upper-division standing. Graded S/F.

MATH 421-422 **3-3 F-W**
Elementary Real Analysis I-II

The fundamental definitions and theorems underlying single-variable calculus and related topics. MATH 421 includes the completeness property, limits of sequences and functions, and continuity. MATH 422 is a continuation that covers derivatives, the Riemann integral, and infinite series. Prerequisites: MATH 132, 275. Even years.

MATH 425 **4 S**
Complex Analysis

The elements of the theory of analytic functions including Cauchy's theorem, calculus of residues, conformality, and applications. Prerequisites: MATH 133, 275. Even years.

MATH 451 **4 W**
History of Mathematics

A survey of major developments in mathematics from antiquity to modern times. Involves historically relevant problem sets, videos, class discussions, and presentations by students and teacher. Prerequisite: MATH 131. Odd years.

MATH 465 **4 S**
Linear Algebra

A deeper study than given in MATH 265, including Jordan form, inner product spaces, quadratic forms, Hamilton-Cayley theorem, and normal operators. Prerequisites: MATH 265, 351. Odd years.

MATH 485 **1-4 S**
Special Topics in Mathematics

Study of a selected topic not covered elsewhere in the curriculum. Course content varies from year to year, reflecting current interest. Topics studied in recent years have been Differential Geometry, Set Theory and Cardinal Numbers, Formal Logic and Godel's Theorem, Topology, Chaos and Fractals. Repeatable for credit. Generally offered every other year. Further information is available at the departmental office.

MATH 490 **1 S**
Senior Seminar

Topics of current interest in mathematics and mathematics education, including applications of mathematics in other fields. Under supervision of departmental faculty, each student prepares and presents a paper on a topic of interest. Prerequisite: MATH 390.

MATH 495 **1-3 F, W, S**
Independent Study

Properly qualified students may, with the approval of the department chair, undertake a directed research problem suited to their background and experience. Repeatable to a maximum of 9 credits.

Statistics

LOWER-DIVISION COURSE:

STAT 222 **4 F, W, S**
Introduction to Statistics

Descriptive statistics, graphical methods, basic concepts of probability, binomial and normal probability distributions, central limit theorem, hypothesis testing involving means, confidence intervals, introduction to correlation and regression, and chi-square testing. Examples from a wide variety of disciplines, including business, the social sciences, and the life sciences, to prepare students with varying backgrounds and interests to become intelligent consumers and users of statistics. Prerequisites: Algebra II in high school (C- or above) or MATH 096, ENGL 101.

UPPER-DIVISION COURSE:

STAT 322 **3 W, S**
Statistical Methods

Linear and multiple regression and correlation, analysis of variance, time series analysis and forecasting, and non-parametric methods. Prerequisites: STAT 222, INFS 148 or equivalent.

