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ACADEMIC PROGRAMS



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Bachelor of Arts in Mathematics Course Programs / Bachelor of Science in Mathematics Course Programs / Sample Four-Year Program for Bachelor of Arts in Mathematics / Cooperative Master of Arts or Minor in Applied Statistics / Preparation for Teaching / Individual Class Descriptions

Programs offered

- Bachelor of Arts in Mathematics
- Bachelor of Science in Mathematics
- Cooperative Master of Arts in Mathematics (with San Francisco State University)
- Minor in Mathematics
- Minor in Applied Statistics
- Preparation For Teaching
- Preparation For Actuary Exam

Mathematics is a rapidly growing discipline whose concepts and applications play an ever-increasing part in modern life. Mathematics has always been an essential tool in the physical sciences, and has more recently been applied extensively in such diverse areas as medical and biological research, environmental studies, management science, behavioral and social sciences, statistics, and, of course, computer science.

Our basic curriculum is designed to give students the mathematical skills necessary for success in business, industry, government, and teaching, as well as to provide a sound background for continuation of study toward advanced degrees in mathematics, computer science, statistics, and related fields.

The B.A. program provides preparation for teaching, general application of mathematics, and graduate study in mathematics.

The B.S. degree program offers concentrations in applied mathematics, computer science, and statistics. These programs prepare students for graduate study in mathematics and in a variety of other fields: computer science; statistical work in government and industry; biostatistics; actuarial work; and consultative problem solving in modern industry.

Degree Requirements

General education	Units 51
Major	45-55

Electives	14-24
Total units needed for graduation	120
Core Curriculum	
MATH 161 Calculus I (3 units in GE)	4
MATH 211 Calculus II	4
MATH 220 Higher Mathematics: An Introduction	3
MATH 241 Calculus III: Differential Equations with Linear Algebra	4
MATH 261 Calculus IV: Multivariable Calculus	4
MATH 340 Real Analysis I	4
Total units in core curriculum	23

B.A. Program (Pure Mathematics)

Core curriculum 23 plus

MATH 306 Number Theory or	
MATH 308 Geometry	3
MATH 320 Modern Algebra I	4
MATH 322 Linear Algebra	3
MATH 360 Complex Variables	3
MATH 418 Topology or	
MATH 420 Modern Algebra II or	
MATH 440 Real Analysis II	3

Supporting Courses

MATH 180 Computing for Math/Science or	
CS 150 Intro to Programming (3 units in GE)	2-4
PHYS 114 Intro to Physics (3 units in GE)	4

Total units in B.A. Program **45-47**

B.A. Program (Secondary Teaching)

This B.A. Program satisfies state requirements for subject matter preparations in mathematics for the Single Subject Teaching Credential.

Core curriculum	23 plus
MATH 250 Probability and Statistics	3
MATH 306 Number Theory	3
MATH 308 College Geometry	3
MATH 310 History of Mathematics	3
MATH 316 Graph Theory and Combinatorics or	3
MATH 416 Graph Theory and Combinatorics	3
MATH 320 Modern Algebra I	4
MATH 345 Probability Theory or	
MATH 470 Mathematical Modeling	3
MATH 395 Community Involvement Program	2

Supporting Courses

MATH 180 Computing for Math/Science	2
PHYS 114 Intro to Physics (3 units in GE)	4

Total units in secondary teaching program **53**

Note: Students considering graduate school in mathematics are advised to choose MATH 322 as an additional course.

B.S. Program (Applied Mathematics)

This B.S. concentration prepares students for employment in industry and graduate schools in scientific fields.

Core curriculum	23
MATH 316 Graph Theory and Combinatorics or	
MATH 416 Graph Theory and Combinatorics	3
MATH 322 Linear Algebra	3
MATH 331 Differential Equations II	3
MATH 345 Probability Theory	3
MATH 352 Numerical Analysis	3
MATH 360 Complex Variables or	
MATH 431 Partial Differential Equations	3
MATH 441 Operations Research	3
MATH 470 Mathematical Modeling	3
 Supporting Courses	
MATH 180 Computing for Math/Science	2
PHYS 114 Intro to Physics (3 units in GE)	4
Total units in applied mathematics program	53

B.S. Program (Computer Science Option)

This B.S. concentration prepares students for computer industry employment and graduate schools in computer-science-related fields. Students who are interested in the mathematical foundations of computer science generally opt for this major.

Core curriculum	23
MATH 316 Graph Theory and Combinatorics or	
MATH 416 Graph Theory and Combinatorics	3
MATH 322 Linear Algebra	3
MATH 345 Probability Theory	3
MATH 352 Numerical Analysis	3
CS 110 UNIX	1
CS 115 Programming I	4
CS 215 Programming II	3
CS 315 Data Structures	3
CS 415 Algorithm Analysis (3) or	
CS 355 Database Management Systems Design (3)* or	
CS 375 Computer Graphics (3)* or	
CS 454 Theory of Computation*	3

* Course may be substituted by arrangement with the math advisor.

Supporting Course

PHYS 114 Intro to Physics	4
Total units in computer science option	53

B.S. Program (Statistics)

This B.S. concentration prepares students for employment in statistical or actuarial fields and for graduate study in statistics.

Core curriculum	23
MATH 322 Linear Algebra	3
MATH 345 Probability Theory	3
MATH 365 Statistical Inference I	4
MATH 367 Statistical Consulting (2 units, twice)	4
MATH 441 Operations Research	3
MATH 465 Statistical Inference II	4
MATH 470 Mathematical Modeling	3

Supporting Courses

MATH 181 Computing for Statistics	2
PHYS 114 Intro to Physics	4
Total units in statistics	53

Sample Four-year Program for Bachelor of Arts in Mathematics**Freshman Year: 30 Units****Fall Semester (15 Units)**

MATH 161 (GE) (4)
 GE (3)
 ENGL 101 (3)
 GE (3)
 Freshman Seminar (3)

Spring Semester (14 Units)

MATH 211 (4)
 PHYS 114 (GE) (4)
 MATH 180 (2)
 GE (3)
 MATH 175 (elective) (1)

Sophomore Year: 29 Units**Fall Semester (13 Units)**

MATH 241 (4)
 MATH 220 (3)
 GE (3)
 GE (3)

Spring Semester (16 Units)

MATH 261 (4)
 MATH 322 (3)
 GE (3)
 GE (3)
 GE (3)

Junior Year: 32 Units**Fall Semester (16 Units)**

MATH 308 or Elective (3)
 MATH 320 (4)
 GE (3)
 GE (3)
 UD GE (3)

Spring Semester (16 Units)

MATH 340 (4)
 Elective or MATH 306 (3)
 GE (3)
 UD GE (3)
 GE (3)

Senior Year: 30 Units**Fall Semester (16 Units)**

MATH 418 or 440 or Elective (3)
 UD GE (3)
 Elective (3)
 Elective (3)
 Elective (4)

Spring Semester (13 Units)

MATH 360 (3)
 MATH 420 or Elective (3)
 Elective (4)
 Elective (3)

Total semester units:**120****Cooperative Master of Arts in Mathematics**

The Department of Mathematics participates in a cooperative Master of Arts in Mathematics with San Francisco State University. Through this program, students who have been accepted into the master's degree program at San Francisco State may complete up to 12 units of course work in residence at Sonoma State University. Students interested in this cooperative program should contact the chair of the Mathematics Department for further information.

Minor in Mathematics

Twenty units of mathematics are required. These must include MATH 161 (or its equivalent) and at least 6 units of upper-division mathematics courses, not including MATH 300A, MATH 300B, MATH 395, or MATH 399. Approval of the Mathematics Department should be obtained by the junior year in order to plan the minor properly.

Minor in Applied Statistics

Twenty units are required. The core required courses are MATH 165, MATH 181, MATH 265, and MATH 367 (twice). Seven additional units may be selected from statistically relevant courses in the Department or elsewhere at Sonoma State University. A total of at least 6 upper-division units must be taken.

Actuarial Science Career Preparation

Students interested in a career in Actuarial Science can prepare to take the first two actuarial examinations by taking the following courses:

1. For Actuarial Exam 1: MATH 161, MATH 211, MATH 222 or MATH 241, MATH 261, MATH 345, and MATH 365.
2. For Actuarial Exam 2: ECON 201A, ECON 201B, ECON 304, MATH 303, ECON 305, and BUS 470.

Preparation for Teaching

Secondary

The B.A. Program for secondary teaching is designed for students planning to teach mathematics in middle, junior high, and high schools. This program is fully accredited by the California Commission on Teacher Credentialing and satisfies the subject matter competence requirement for a Single Subject Teaching Credential. (An alternative route for demonstrating subject matter competence is passing a battery of commercial exams.) Most students complete the B.A. Program, then a one-year teaching credential program to earn the Single Subject Credential.

An Integrated Program for mathematics and a teaching credential is now available to freshmen. Students in this program take coursework in education along with mathematics and General Education throughout their undergraduate years, eventually graduating with both a B.A. and a teaching credential simultaneously. The Integrated Program requires formal application to SSU's Single Subject Program prior to the junior year.

A student interested in any of the secondary teaching options should consult the Mathematics Department's education advisor.

Elementary

The Department of Mathematics also offers course work for students planning to teach in elementary schools or preschools. The minimal college-level mathematics preparation recommended for elementary teachers is three courses: MATH 150, MATH 300A, and MATH 300B. Particular subject matter preparation programs for elementary teachers may have additional requirements or may offer the option of a mathematics concentration; consult advisors in the program for additional details.

Supplementary Authorization

Students planning to earn either the Multiple Subject (elementary), Single Subject (secondary), or Special Education credential may further emphasize mathematics in their teaching preparation by completing coursework leading to a supplementary authorization in mathematics. This addition to the credential qualifies the holder to teach in mathematics-only classes up through ninth-grade-

level math. The supplementary authorization can also be combined with a mathematics minor. Interested students should consult the Mathematics Department's education advisor.

Entry-Level Mathematics (ELM) Requirement

Unless exempted, the Entry-Level Mathematics Examination must be taken within the past two years before enrollment in any general education course or developmental mathematics course (MATH 35 or 45). The ELM results will place the student in the appropriate level of mathematics courses. Note that if placement in the developmental mathematics sequence is necessary, satisfactory completion of MATH 45 is required for placement in MATH 103, 104, 105, 107, 111, 131, 141, 150, and 165. Please consult the Schedule of Classes or phone the Office of Testing Services for times and places of examination. The examination will be given in conjunction with the English Placement Test. For additional information, please see the Admissions section of this catalog.

Grading Policy in the Mathematics Department

Nonmajors

All mathematics courses except MATH 35, 45, 103, 104, 105, 107, 111, 131, 141, 150, 161, and 165 are available in the Cr/NC grading mode to nonmathematics majors.

All Students

MATH 175, 295, 330, 395, and 499 are available only as Cr/NC.

Mathematics Majors

A mathematics major must take all mathematics courses in the traditional grading mode, with the exceptions of courses offered only in the Cr/NC modes: MATH 107W, 161W, 175, 211W, 295, 330, 395, and 499, and any course taken as credit by challenge examination (please see more information on this in the Admissions section of this catalog). However, a maximum of 6 units total credit in MATH 330, 375, 395, and 499 may be applied toward any mathematics degree.

Majors are advised to take PHIL 102 for the GE category A3 (Critical Thinking).

Mathematics Courses (MATH)

Classes are normally offered in the semesters indicated. Please see the Schedule of Classes for most current information and faculty teaching assignments.

35 Elementary Algebra (4) Fall, Spring

Real numbers, linear equations and inequalities, quadratic equations, polynomial operations, radical and exponential expressions. Prerequisite: placement based on ELM examination taken within the past two years. Course credit is not applicable toward graduation.

45 Intermediate Algebra (4) Fall, Spring

Linear, quadratic, radical, rational, exponential, and logarithmic functions and their graphs. Prerequisite: MATH 35 or equivalent, or placement based on ELM examination taken within the past two years. Course credit is not applicable toward graduation.

103 Ethnomathematics (3) Fall

This course examines the mathematics of many indigenous cultures, especially those of North and South America, Africa, and Oceania. It will examine the use of mathematics in commerce, land measure and surveying, games, kinship, measurement of time, navigation, data storage, and other topics. The mathematics involved includes number bases, probability, geometry, number theory, lattice theory, and many other topics of interest in modern mathematics. This class is recommended for liberal arts students who are interested in studying other cultures. Satisfies GE requirement for mathematics, category B4. Prerequisite: satisfaction of ELM requirement.

104 Introduction to Modern Mathematics (3) Fall, Spring

A class designed to explore the beauty and relevance of mathematics. Topics may include puzzles, paradoxes, and logic; axiomatic systems; biographies; infinity of the counting numbers and higher infinities; historical crises and breakthroughs in mathematics; and uncertainty. This class is recommended for liberal arts students. Satisfies GE requirement for mathematics, category B4. Prerequisite: satisfaction of ELM requirement.

105 Mathematics and Politics (3) Spring

This course will explore mathematical achievements in the theory of politics. Topics may include: escalation, conflict, yes/no voting, political power, and social choice. This course has an enormous cultural content, while at the same time dealing with important mathematical ideas. This class is especially suitable for social science students. Satisfies GE requirement for mathematics, category B4. Prerequisite: satisfaction of ELM requirement.

107 Precalculus Mathematics (4) Fall, Spring

Covers a brief review of college algebra; functional notation, composition and decomposition of functions, inverse functions; behavior of families of functions such as polynomial, rational, exponential, and logarithmic; trigonometric functions, equations, and identities; some mathematical modeling. Emphasis on problem solving. Satisfies the GE requirement for mathematics, category B4. Prerequisite: satisfaction of ELM requirement. CAN MATH 16.

107W Precalculus Workshop (2) Fall, Spring

A workshop designed to be taken with MATH 107. Exploration of precalculus concepts through problem solving in a group setting. Cr/NC only. Corequisite: MATH 107.

111 Symmetry in the Sciences and Arts (3) Spring

Exploration of the mathematical theory of symmetry in the plane and in space. The theory uses the idea that the set of rigid motions comprises an algebraic structure called a group, and that composing rigid motions corresponds to performing an algebraic operation. The course emphasizes how the mathematical theory aids in understanding the causes and consequences of symmetry in natural and man-made objects. A central theme is the contribution of mathematics to other fields, such as architecture and the decorative arts; engineering of mechanical devices; music and dance; evolution and anatomy; crystallography; chemical bonding and atomic structure; philosophy; and mathematical proofs. Satisfies GE requirement for mathematics, category B4. Prerequisite: satisfaction of ELM requirement. High School geometry is highly recommended.

131 Introduction to Finite Mathematics (3) Fall, Spring

A GE course designed to give students an understanding of finite mathematics applied in the modern world to social sciences, economic analysis, statistical analysis, and decision making. Topics include linear models, linear programming, financial mathematics, sets, combinatorics, probability, and statistics. Recommended for students with interests in the social sciences and management. Satisfies GE requirement for mathematics, category B4. Prerequisite: satisfaction of ELM requirement.

141 Studies in . . . (3) Fall, Spring

Topics and approaches may vary. Please consult the current Schedule of Classes for details. Satisfies the GE requirement for mathematics, category B4. Prerequisite: satisfaction of ELM requirement.

142 Discrete Structures I (3) Fall, Spring

A study of discrete structures that have applications in computer science. Topics will include logic, proofs, mathematical induction, set theory, relations, functions, directed graphs, and Boolean algebra. Throughout the course, applications to computer science, such as grammars and finite state machines, languages, and Karnaugh maps will be discussed. Prerequisites: MATH 107 or equivalent, or consent of instructor.

150 Geometry (3) Fall, Spring

A study of Euclidean geometry. It will cover topics such as compass and straightedge constructions, proofs, parallel and perpendicular lines, triangles, circles, polygons, measurement, solids, transformations, tessellations, and the use of geometry software. Satisfies the GE

requirement for mathematics, category B4 and is strongly recommended for prospective elementary and middle school teachers. Prerequisite: satisfaction of ELM requirement.

161 Calculus I (4) Fall, Spring

Calculus I includes limits, continuity, derivatives including trigonometric functions, chain rule, curve sketching, extremum problems, L'Hospital's rule, implicit differentiation, related rates, Mean Value Theorem, introduction to integration, fundamental theorem of calculus, substitution, and applications. Satisfies the GE requirement for mathematics, category B4. Prerequisite: MATH 107 or consent of instructor. CAN MATH 18.

161W Calculus I Workshop (2) Fall, Spring

A workshop designed to be taken with MATH 161. Exploration of first-semester calculus concepts through problem solving in a group setting. Cr/NC only. Corequisite: MATH 161.

165 Elementary Statistics (4) Fall, Spring

This course is a computer-intensive introduction to elementary statistics. Topics include: elementary descriptive and inferential statistics and their application to the behavioral, natural, and social sciences; discrete probability theory; sampling; random variables; special distributions; central limit theorem; estimation; tests of hypothesis; analysis of variance; linear regression and correlation; and some nonparametric tests. Satisfies the GE requirement for mathematics, category B4. Prerequisite: satisfaction of ELM requirement. CAN STAT 2.

175 M*A*T*H Colloquium (1) Fall, Spring

A student taking this course will be required to attend presentations in the M*A*T*H Colloquium series during the semester and, in addition, keep a journal. May be taken three times for credit. Cr/NC only. Prerequisite: consent of instructor. See also MATH 375.

180 Computing for Mathematics and Science (2) Fall

This course utilizes a software system, such as Mathematica, to implement numerical, symbolic, and graphical computations useful in mathematics and science. It also introduces students to procedural programming in that system. Prerequisite: MATH 161 or consent of instructor.

181 Computing for Statistics (2) Spring

Students will learn how to use high-level statistical software packages such as SAS or SPSS to perform statistical analysis, understand computer output, interpret statistical results and write their own programs. Prerequisite: MATH 265 or MATH 365, or concurrent enrollment; or consent of instructor.

185 Selected Topics in Mathematics (1-5) Fall, Spring

Subject matter to be determined by instructor and may differ from semester to semester. This course may be repeated with different subject matter for up to 12 units. The course title will appear on the student's transcript. Prerequisite: consent of instructor.

195 Special Studies (1-4)

Special Studies may be arranged to cover an area of interest not covered in lower division courses otherwise offered by the department. Prerequisites: Lower division standing and consent of instructor.

200 Discrete Mathematics (3) Spring

Designed for elementary and middle school teachers, this course is a study of discrete mathematics with emphasis on its use in other areas of mathematics and in real world problems. Topics include selections from logic, proof, coding and cryptography, set theory, sequences, mathematical induction, combinatorics, graphs, and others as selected by the instructor. Prerequisite: A GE Mathematics class or consent of instructor.

211 Calculus II (4) Fall, Spring

Calculus II includes the calculus of exponential and logarithmic functions; trigonometric and inverse trigonometric functions; numerical integration; techniques of integration; introduction to applications of integration including volumes and probability distributions; differential equations; Taylor polynomials; improper integrals; series; and introduction to partial derivatives. Prerequisite: MATH 161 or consent of instructor. CAN MATH 20.

211S Calculus II-S (2) Fall, Spring

First half of MATH 211. Prerequisites: MATH 161 or consent of instructor. Open only to students enrolled in programs that require MATH 211S.

211W Calculus II Workshop (1) Fall, Spring

A workshop designed to be taken with MATH 211. Exploration of second semester calculus concepts through problem solving in a group setting. Cr/NC only. Corequisite: MATH 211.

220 Higher Mathematics: An Introduction (3) Fall, Spring

This is a transitional course supplying background for students going from calculus to the more abstract upper-division mathematics courses. The principal aim of this course is to develop proficiency in reading and creating proofs. The following topics are included: elementary logic, methods of proof, set theory, relations, and functions. Topics that may be covered include: algebras, homomorphisms, cardinality, Boolean algebra, the integers, limits, and the real numbers. Transfer students are encouraged to take MATH 220 during their first semester here. Prerequisite: MATH 211 or equivalent, or consent of instructor.

222 Elementary Applied Linear Algebra (3) Fall

A course in vector and matrix algebra applied to science and computing. Topics include systems of linear equations, determinants, Euclidean and general vector spaces, eigenvalues and eigenvectors, linear transformations. Prerequisite: MATH 107 or consent of instructor. CAN MATH 26.

241 Calculus III: Differential Equations with Linear Algebra (3) Fall, Spring

A course in vector and matrix algebra applied to the study of differential equations. Topics include vectors and matrices, linear independence, spanning, bases, linear transformations, first order differential equations and linear systems, phase planes, geometric and numerical methods. Prerequisite: MATH 211 or equivalent, or consent of instructor.

250 Probability and Statistics (3) Fall

A study of elementary probability and statistics and their uses in real-world contexts. Topics include: the binomial distribution; conditional probability; expected value; data collection and sampling; measures of location and variability; correlation and regression; estimation; and simple hypothesis testing. This course is designed for teachers and may not be substituted for MATH 165. Prerequisite: Any GE-level math course or consent of instructor.

261 Calculus IV: Multivariable Calculus (4) Fall, Spring

Calculus IV includes partial derivatives; multiple integrals; alternative coordinate systems; vector functions and their derivatives; line integrals; Green's Theorem; Stoke's Theorem; Divergence Theorem. Prerequisites: MATH 241 or equivalent, or both PHYS 114 and MATH 211 or consent of instructor. CAN MATH 22.

265 Intermediate Statistics (3) Spring

An in-depth examination of the application of statistical techniques to the real world. The course extends the concepts learned in MATH 165, and introduces new topics; it is suitable for students with an interest in applying statistics to their field of interest. Topics selected from: theory of estimation; ANOVA (analysis of variance); multiple regression; principles of experimental design; sampling theory; time series analysis; and multivariate analysis. Prerequisite: MATH 165 or MATH 250 or instructor consent.

295 Community Involvement Program (1-4) Fall, Spring

CIP involves students in basic community problems, performing such tasks as tutoring, coaching, and reading for the blind. Students receive 1 to 4 units, depending on the specific tasks performed.

No more than 3 units of credit in CIP may be applied toward any mathematics degree. May be repeated for credit up to 6 units total. Cr/NC only.

300A Elementary Number Systems (3) Fall, Spring

This course, designed for prospective elementary and middle school teachers, explores numerical ideas and processes underlying the K-8 mathematics curriculum. The emphasis is on understanding the mathematical ideas and procedures, and on representing them in ways that children can understand. Alternative ways of representing and solving problems are encouraged. Problem solving, reasoning, and alternative strategies are emphasized throughout. Prerequisite: MATH 150 or other GE Math course or consent of instructor.

300B Data, Chance, and Algebra (3) Fall, Spring

This course is designed for prospective elementary and middle school teachers. The focus in algebra is on patterns and functions; algebraic structure; representations and connections; and reasoning and problem solving. The focus in data and chance is on developing solid understanding of fundamental concepts and skills in statistics and probability, and on enhancing students' understanding and skills in number and computation, proportional reasoning, and algebra. Prerequisite: MATH 300A or consent of instructor.

303 Interest Theory (3)

Basic interest theory, including patterns of growth, interest operations, level payment annuities, non-level payment annuities, yield rates, amortization, sinking funds, and bonds. Prerequisite: MATH 161 or equivalent or consent of instructor.

306 Number Theory (3) Spring

Topics may include mathematical induction, Euclidean algorithm, congruencies, fundamental theorem of arithmetic, perfect numbers, number theoretic functions, prime number theorem. Prerequisite: MATH 142 or MATH 200 or MATH 220 or consent of instructor.

308 College Geometry (3) Fall

Topics may include the Hilbert postulates, isometries in the Euclidean plane, non-Euclidean geometries, projective geometry, construction of geometries from fields. Prerequisites: MATH 220 and either MATH 222 or MATH 241 or consent of instructor. Any student who has not taken high school geometry is advised to take MATH 150 before MATH 308.

310 History of Mathematics (3) Spring

Mathematics from ancient times to the present. The student learns how to solve problems of the past using only the tools of the past. Prerequisite: MATH 161 or consent of instructor.

316 Graph Theory and Combinatorics (3) Spring

Set theory, counting techniques such as permutations, combinations, generating functions, partitions and recurrence relations, Polya's theorem, Hamiltonian and Eulerian properties of graphs, matchings, trees, coloring problems, and planarity. Applications in many disciplines. Students may not earn credit for both MATH 316 and MATH 416. Prerequisite: MATH 142 or MATH 200 or MATH 220 or consent of instructor.

320 Modern Algebra I (4) Fall

An introduction to the theory of groups, rings, and fields. Topics covered include: permutation and cyclic groups; factor groups; ideals and factor rings; and isomorphism and homomorphism theory of groups and rings.

322 Linear Algebra (3) Spring

Topics include applications using linear models, vector spaces, linear transformations, matrices, linear equations, determinants, and the Cayley-Hamilton theorem. Prerequisites: MATH 220 and either MATH 222 or MATH 241 or consent of instructor.

330 Techniques of Problem Solving (2)

Cultivates by experience and example the mental disciplines for generating creative solutions to challenging problems. The problems to be considered will be taken largely from recent examinations in the William Lowell Putnam Mathematical Competition, sponsored by the Mathematical Association of America. No more than 4 units of credit in this course may be applied toward any mathematics degree. May be taken four times for credit. Cr/NC only. Prerequisite: MATH 161 or consent of instructor.

331 Differential Equations II (3) Spring

Topics may include Picard's method and a discussion of the existence and uniqueness of solutions. General properties of solutions, including the Sturm separation theorem for second-order linear equations. Power series solutions for a regular singular point. Laplace transform. Linear systems of differential equations. Nonlinear differential equations and stability. Prerequisite: MATH 241 or consent of instructor.

340 Real Analysis I (4) Spring

Topics include construction of the real numbers, topology of real numbers, metric spaces, continuity, the derivative, the Riemann integral, and sequences and series. Prerequisites: MATH 220 and MATH 261, or consent of instructor.

342 Discrete Structures II (3) Fall, Spring

A study of discrete structures that have applications in computer science. Topics will include: combinatorics and counting, probability and statistics, matrices, recurrence relations, generating functions, and graph theory. Throughout the course, applications to computer science will be discussed. Prerequisite: consent of instructor, or MATH 211 and one of the following: MATH 142, MATH 200, or MATH 220.

345 Probability Theory (3) Fall

Topics include: probability spaces, discrete and continuous random variables, probability mass functions, probability density functions, cumulative distribution functions, Markov chains, queueing theory, moment generating functions, law of large numbers, and central limit theorem. Prerequisites: MATH 261 (may be taken concurrently) and MATH 220, or consent of instructor.

352 Numerical Analysis (3) Fall

Selected numerical and iterative processes for solving equations. Topics include computer methods, finite differences, Lagrange interpolations. Introduction to the finite element method and the theory of spline functions. Prerequisites: MATH 241 (may take concurrently) and MATH 180 or CS 150 or competence in a high-level programming language, or consent of instructor.

360 Introduction to Complex Variables (3) Fall 2004; Spring 2006

Topics include the complex field, functions, limits, continuity, complex differentiation and the Cauchy-Riemann equations, complex integration, residues, conformal mappings. Prerequisite: MATH 220, or concurrent enrollment in MATH 261, or consent of instructor. MATH 241 and MATH 340 are recommended.

365 Statistical Inference I (4) Spring

A course in mathematical statistics, concerned with developing the concepts of statistics by the use of calculus. Topics include: theory of sampling, problem of estimation, tests of significance, confidence limits, the t, F, and chi-square distributions. Prerequisite: MATH 345 or consent of instructor.

367 Statistical Consulting (2) Fall, Spring

This course is a blend of theoretical and practical aspects of statistical consulting. Students learn how to consult with professionals in various fields, find creative statistical solutions to real-world problems and present results in oral and written form. Students also learn about library research and statistical software packages. This course may be repeated for a total of 4 units. Prerequisite: MATH 165 or MATH 250 or MATH 265 or MATH 365 or consent of instructor.

375 M*A*T*H Colloquium (1) Fall, Spring

Students will be required to attend presentations, keep a journal, and write a significant paper on one of the presentations. May be taken three times for credit. No more than 3 units may be applied to the upper-division major requirement. May not be taken concurrently with MATH 175.

Prerequisites: consent of instructor and upper-division standing. (similar to MATH 175)

395 Community Involvement Program (1-4) Fall, Spring

CIP involves students in the community performing such tasks as tutoring, coaching, and reading for the blind. Students receive 1 to 4 units, depending on the specific tasks performed. No more than 3 units of credit in CIP may be applied toward any mathematics degree. May be repeated for a total of 6 units. Cr/NC only.

399 Practicum in Mathematics (1-4) Fall, Spring

Supervised unpaid instructional work experience in mathematics. May include tutoring, assisting with classroom activities, and leading supplementary course workshops. Thirty hours of contact time is required for each unit. Does not count for credit in the major or the minor, except for one unit in the Integrated Program. May be repeated for up to 4 units of credit. Prerequisite: requires previous or concurrent enrollment in an upper-division mathematics course and consent of instructor. Cr/NC only.

416 Graph Theory and Combinatorics (3) Spring

Set theory; counting techniques such as permutations; combinations, generating functions, partitions and recurrence relations; Polya's theorem; Hamiltonian and Eulerian properties of graphs; matchings; trees; coloring problems; and planarity. Applications in many disciplines. MATH 416 covers the same topics as MATH 316. Students taking MATH 416 will work advanced problems from these topics and do a special research project which requires a significant paper and an oral presentation. Students may not earn credit for both MATH 316 and MATH 416. Prerequisite: MATH 142 or MATH 200 or MATH 220 or consent of instructor.

418 General Topology (3) Fall, even years

Topics include: definition of a topology, closed sets, relativizations, bases and subbases of a topology, compact topological spaces, separation axioms, normal spaces, regular spaces, metric spaces, continuous mappings, product spaces, function spaces. Prerequisite: MATH 340 or consent of instructor.

420 Modern Algebra II (3) Spring, even years

A continuation of MATH 320. Advanced topics in the theory of groups, rings, and fields. Coverage may include topics such as the direct product of groups, finite abelian groups, Sylow Theorems, unique factorization domains, field extensions, and Galois Theory. Prerequisite: MATH 350 or consent of instructor.

430 Linear Systems Theory (3) Fall

Topics may include: correlation, convolution, Fourier, Laplace and z-transform, difference equations, fast Fourier transforms' and state variable theory. Prerequisite: one semester of differential equations (such as MATH 241) or consent of instructor.

431 Partial Differential Equations (3) Fall 2004

A course in partial differential equations (PDEs). Topics include: mathematical models in physics, theory, and solution of quasi-linear first-order PDEs; second-order linear and nonlinear PDEs, including applications. Fourier series, boundary-value problems, Fourier and Laplace transforms. Numerical methods and solutions. Prerequisite: MATH 241 or consent of instructor.

440 Real Analysis II (3) Fall, odd years

A continuation of MATH 340. Topics include: sequences and series of functions, Taylor series, Weierstrass approximation theorem, Fourier series, and the Lebesgue integral. Prerequisite: MATH 340 or consent of instructor.

441 Operations Research (3) Spring 2005; Fall 2006

A course in operations research and industrial problem solving. Topics include optimization, simplex algorithm for linear programming, queueing theory, game theory, PERT least time path analysis, mathematical modeling of industrial problems. Prerequisites: MATH 345 and either MATH 241 or MATH 222, or consent of instructor.

465 Statistical Inference II (4) Fall

Topics will include: general linear hypothesis, linear and nonlinear regression, analysis of variance, design of experiments, multivariate analysis. Computer use will illustrate real-world applications of the theory. Prerequisites: MATH 181 and MATH 365, or consent of instructor.

470 Mathematical Models (3) Fall

The process of expressing scientific principles, experiments, and conjectures in mathematical terms. Topics include: gathering reliable data, exposing underlying assumptions, variables, and relationships. Choice of modeling levels. Testing and refining of models. Deterministic vs. stochastic models. Applications to biology, physics, chemistry, geology, social science, and environmental sciences. Prerequisite: MATH 211 or consent of instructor.

485 Selected Topics in... (1-3)

Subject matter and number of units to be determined by the instructor and may differ from semester to semester. Some of the possible areas of study are multivariable analysis, calculus of variations, convex geometry, differentiable manifolds, graph theory, Galois theory, algebraic topology, integral equations. This course may be repeated for up to 6 units. The course title will appear on the student's transcript. Prerequisite: consent of instructor.

495 Special Studies (1-4) Fall, Spring

Special Studies may be arranged to cover an area of interest not covered in upper division courses otherwise offered by the department. Prerequisites: a upper-division standing and consent of instructor.

496 Proseminar in Mathematics (1-3)

A mutual exploration of selected current issues in mathematics by members of the mathematics faculty and mathematics majors. Non-majors may enroll by permission of the instructors. Prerequisite: upper-division standing.

499 Internship in Mathematics (1-3)

Field experience in mathematics, computer science, or statistics. May be repeated for credit up to 3 units total. Cr/NC only. Prerequisite: prior arrangement with instructor.

Graduate Courses

595 Special Studies in Mathematics (1-4)

Subject matter and number of units to be determined by instructor and may differ from semester to semester. This course may be repeated with different subject matter for up to 12 units. The course title will appear on the student's transcript. Prerequisite: consent of instructor.

SONOMA STATE UNIVERSITY

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