MATHEMATICS (MATH)

MATH 1. Mathematical Reasoning. 3 Units
Prerequisite(s): MATH 9 or three years of high school mathematics which includes two years of algebra and one year of geometry; and completion of ELM requirement.
General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)
Recommended for students whose majors do not include a specific mathematics requirement. Objectives are to show some of the essence and quality of mathematics, and to enhance precision in the evaluation and expression of ideas, thereby developing a student's quantitative reasoning skills. Designed to give students an understanding of some of the vocabulary, methods, and reasoning of mathematics with a focus on ideas.

MATH 9. Essentials of Algebra and Trigonometry. 3 Units
Prerequisite(s): One year each of high school algebra and geometry; and a passing score on the Elementary Algebra Diagnostic Test.
Prepares students, especially in bioscience, economics and social science, for courses requiring basic algebra and trigonometry. Topics: measurement and scientific notation; review of basic algebra; factoring; laws of exponents; linear and quadratic equations; Cartesian coordinates and graphing; the trigonometric functions and their basic identities; solutions of right triangles; the laws of sines, cosines and tangents; solutions of general triangles; logarithms.
Note: Applicable to workload credit for establishing full-time enrollment status, but not applicable to the baccalaureate degree.

MATH 11. Algebra for College Students. 4 Units
Prerequisite(s): A passing score on the Intermediate Algebra Diagnostic Test.
Prepares students for Precalculus and other courses requiring algebra. Linear equations and inequalities, absolute value equations and inequalities, systems of linear equations, quadratic equations, polynomial expressions and equations, rational expressions and equations, roots and radicals, and exponential and logarithmic equations.
Note: Applicable to workload credit for establishing full-time enrollment status, but not applicable to the baccalaureate degree.

MATH 15H. Honors Mathematical Reasoning. 3 Units
Prerequisite(s): Open only to Honors students.
General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)
Introduction to the composition and interpretation of mathematical ideas and to the mathematical reasoning necessary to derive results in a variety of mathematical topics. Emphasis on developing concepts and analyzing results.

MATH 17. An Introduction to Exploration, Conjecture, and Proof in Mathematics. 3 Units
Prerequisite(s): MATH 9 or three years of high school mathematics which includes two years of algebra and one year of geometry; completion of ELM requirement and the Intermediate Algebra Diagnostic Test.
General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)
Prepares students for MATH 107A and MATH 107B. Students will explore mathematical patterns and relations, formulate conjectures, and prove their conjectures. Topics from number theory, probability and statistics, and geometry.

MATH 24. Modern Business Mathematics. 3 Units
Prerequisite(s): MATH 9 or three years of high school math that includes two years of algebra and one year of geometry; completion of ELM requirement and the Intermediate Algebra Diagnostic Test.
General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)
Mathematics for business world, including functions, math of finance, linear programming and rates of change. Applications to economics and business will be emphasized throughout.

MATH 26A. Calculus I for the Social and Life Sciences. 3 Units
Prerequisite(s): MATH 11 or three years of high school mathematics which includes two years of algebra and one year of geometry; completion of ELM requirement and the Intermediate Algebra Diagnostic Test.
General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)
Limits, differentiation with applications, integration and applications in the Social Sciences and Life Sciences.

MATH 26B. Calculus II for the Social and Life Sciences. 3 Units
Prerequisite(s): MATH 26A or appropriate high school based AP credit.
General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)
Continuation of MATH 26A, integration and applications to the Social Sciences and Life Sciences. Multi-variate analysis including partial differentiation and maximization subject to constraints; elementary differential equations; sequences and series. Calculus of the trigonometric functions as time allows.
Note: Not open to students already having credit for MATH 31 or equivalent.

MATH 29. Pre-Calculus Mathematics. 4 Units
Prerequisite(s): MATH 11 or three years of high school mathematics which includes two years of algebra and one year of geometry; completion of ELM requirement and Intermediate Algebra Diagnostic Test.
General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)
Designed to prepare students for calculus. Topics: trigonometry, points and lines in the Cartesian plane; lines and planes in space; transformation of coordinates; the conics; graphs of algebraic relations; the elementary transcendental functions.

MATH 29A. Pre-Calculus Mathematics A. 2 Units
Prerequisite(s): MATH 11 or three years of high school mathematics that includes two years of algebra and one year of geometry; completion of the Intermediate Algebra Diagnostic Test.
Corequisite(s): MATH 29L.
First semester of a two semester course that is designed to prepare students for calculus. Topics: functions and graphs, polynomial functions, rational functions and applications. Lecture two hours.

MATH 29B. Pre-Calculus Mathematics B. 2 Units
Prerequisite(s): MATH 29A.
Corequisite(s): MATH 29M.
Second semester of a two semester course that is designed to prepare students for calculus. Topics: exponential and logarithmic functions, trigonometric functions, analytic geometry, and applications. Lecture two hours.

MATH 29L. Lab for Pre-Calculus Math A. 1 Unit
Corequisite(s): MATH 29B.
Workshop designed to deepen the understanding of pre-calculus developed in MATH 29A.
Note: May be taken for workload credit toward establishing full-time enrollment status, but is not applicable to the baccalaureate degree.
Laboratory

MATH 29M. Lab for Pre-Calculus Math B. 1 Unit
Corequisite(s): MATH 29B.
Workshop designed to deepen the understanding of pre-calculus developed in MATH 29B.
Note: May be taken for workload credit toward establishing full-time enrollment status, but is not applicable to the baccalaureate degree.
Laboratory

MATH 30. Calculus I. 4 Units
Prerequisite(s): MATH 29 or four years of high school mathematics which includes two years of algebra, one year of geometry, and one year of mathematical analysis; completion of ELM requirement and Pre-Calculus Diagnostic Test.
General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)
Functions and their graphs; limits; the derivative and some of its applications; trigonometric and hyperbolic functions and their inverses; the integral; the fundamental theorem; some applications of the integral.

MATH 30L. Laboratory for First Semester Calculus. 1 Unit
Corequisite(s): Enrollment in a designated section of MATH 30.
Workshop designed to deepen the understanding of calculus developed in MATH 30.
Note: May be taken for workload credit toward establishing full-time enrollment status, but is not applicable to the baccalaureate degree.
Laboratory

Credit/No Credit

MATH 31. Calculus II. 4 Units
Prerequisite(s): MATH 30 or appropriate high school based AP credit.
General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)
MATH 30 continuation. Methods of integration; improper integrals; analytic geometry; infinite sequences and series.

MATH 31L. Laboratory for Second Semester Calculus. 1 Unit
Corequisite(s): Enrollment in a designated section of MATH 31.
Workshop designed to deepen the understanding of calculus developed in MATH 31.
Note: May be taken for workload credit toward establishing full-time enrollment status, but is not applicable to the baccalaureate degree.
Laboratory

Credit/No Credit

MATH 32. Calculus III. 4 Units
Prerequisite(s): MATH 31.
Continuation of Calculus II. Algebra and calculus of vectors; functions of several variables; partial differentiation; multiple integration; vector analysis.

MATH 35. Introduction to Linear Algebra. 3 Units
Prerequisite(s): MATH 30 or appropriate high school based AP credit.
General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)
Careful development of matrices, systems of equations, determinants, vector spaces, linear transformations, orthogonality, real and complex eigenvalues; R3 viewed as a vector space with generalization to Rn.

MATH 45. Differential Equations for Science and Engineering. 3 Units
Prerequisite(s): MATH 31.
First order differential equations, second order differential equations with constant coefficients. Laplace transforms, small systems of linear differential equations, numerical methods, introduction to second order differential equations with variable coefficients.

MATH 99. Special Problems. 1 - 6 Units
Individual projects or directed reading.
Note: Open only to students who appear competent to carry on individual work; admission requires the approval of the faculty member under whom individual work is to be conducted, and approval of the advisor and the Department Chair.

Credit/No Credit

MATH 100. Applied Linear Algebra. 3 Units
Prerequisite(s): MATH 26B or MATH 31.
Linear algebra and its elementary applications. Topics: Matrix algebra; simultaneous linear equations; linear dependence and vector spaces; rank and inverses; determinants; numerical solution of simultaneous linear equations; linear transformations; eigenvalues and eigenvectors; unitary and similarity transformations; quadratic forms.
Note: May not be taken for credit toward a mathematics major.

MATH 101. Combinatorics. 3 Units
Prerequisite(s): MATH 31
Introduction to the art of counting. The focus will be on actually listing the objects being counted in small cases and using the knowledge gained in working with small cases to build toward general principles. Sum and product principles, models of counting, permutations and combinations, equivalence relations and partitions, inclusion-exclusion principle, recurrence relations, and generating functions.

MATH 102. Number Theory. 3 Units
Prerequisite(s): MATH 31.
Theory of divisibility; some number theoretical functions; congruencies (linear and quadratic); some Diophantine equations. Simple continued fractions.

MATH 104. Vector Analysis. 3 Units
Prerequisite(s): MATH 32.
Vector and scalar fields, integral theorems, orthogonal curvilinear coordinates, vector spaces and linear transformations, applications to physical fields and operators.

MATH 105A. Advanced Mathematics for Science and Engineering I. 4 Units
Prerequisite(s): MATH 32, MATH 45.
Survey of second order linear differential equations, power series and Fourier series solutions, solution of partial differential equations by separation of variables.

MATH 105B. Advanced Mathematics for Science and Engineering II. 4 Units
Prerequisite(s): MATH 105A.
Partial differential equations continued, complex function theory and its applications.

MATH 107A. Fundamental Mathematical Concepts. 3 Units
Prerequisite(s): MATH 17 and passing score on the Intermediate Algebra Diagnostic Test.
First half of a one-year course in the structure of the real number system and its sub-systems and in the basic properties and concepts of geometry. Topics will include: definitions and properties of set theory and their use in the development of the natural and whole number systems, definitions and properties of the arithmetic relations and operations for the natural numbers, whole numbers, integers.
Note: May not be taken for credit toward a mathematics major or minor.

MATH 107B. Fundamental Mathematical Concepts. 3 Units
Prerequisite(s): MATH 107A.
Continuation of MATH 107A. Topics will include: rational numbers, real numbers, measurement, Euclidean Geometry.
Note: May not be taken for credit toward a mathematics major or minor.

MATH 107C. Elementary Mathematics and the Learning Process. 3 Units
Prerequisite(s): MATH 17, MATH 107A or MATH 107B, and CHDV 30 or CHDV 35.
Students will build on their understanding of material of Math 17, Math 107A/B by deepening their understanding of the concepts taught in these courses. This will be done by examining these concepts in relationship to theories of learning and development. Students will examine mathematical concepts related to K-8 with respect to the treatment of reasoning, communication, and the perspective of cognitive and social constructivism; and throughout the course will consider the question of "What is mathematics?" and "How is mathematics learned?

MATH 108. Introduction to Formal Mathematics. 3 Units
Prerequisite(s): MATH 31, MATH 35.
Logic of mathematical proof, set theory, relations, functions. Examples and applications from set cardinality, algebra, and analysis.

MATH 110A. Modern Algebra. 3 Units
Prerequisite(s): MATH 108.
First half of a one-year introductory course in algebraic concepts. Topics include: groups, subgroups, properties of groups, permutation groups, factor groups, homomorphism theorems.

MATH 110B. Modern Algebra. 3 Units
Prerequisite(s): MATH 110A.
Continuation of MATH 110A.
Note: Topics include

MATH 117. Linear Algebra. 3 Units
Prerequisite(s): MATH 110A.
Abstract linear spaces and linear transformations; invariant subspaces; canonical forms.

MATH 121. College Geometry. 3 Units
Prerequisite(s): MATH 31; MATH 32 or MATH 35.
Study of the axioms and theorems of Euclidean geometry. A comparison of several geometry axiom systems and their theorems, including those of some non-Euclidean and finite geometries.

MATH 130A. Functions of a Real Variable. 3 Units
Prerequisite(s): MATH 32 and MATH 108.
First half of a one-year upper division course in functions of a real variable. The first semester will consist of a rigorous development of the theory of real-valued sequences and continuity and differentiation for functions of one real variable.

MATH 130B. Functions of a Real Variable. 3 Units
Prerequisite(s): MATH 130A.
Continuation of MATH 130A. This semester will be devoted to a rigorous development of the theory of Riemann integration, infinite series, and sequences and series of functions.

MATH 134. Functions of a Complex Variable and Applications. 3 Units
Prerequisite(s): MATH 32.
Complex plane; analytic functions; integration and Cauchy's Theorem; sequences and series; residue calculus; applications to potential theory; Fourier and Laplace transforms.

MATH 150. Introduction to Numerical Analysis. 3 Units
Prerequisite(s): MATH 31
Numerical solutions of algebraic and transcendental equations; interpolation, inverse interpolation, finite differences, cubic splines, and applications; numerical differentiation and integration; direct and iterative numerical solutions of linear systems; discrete and continuous least squares approximation.

MATH 161. Mathematical Logic. 3 Units
Prerequisite(s): MATH 108.
Advanced study of logic with special application to mathematics.

MATH 162. Set Theory. 3 Units
Prerequisite(s): MATH 108.
Axiomatic study of set theory. Topics usually considered include: relations and functions; set theoretical equivalence; finite and infinite sets; cardinal arithmetic; ordinal numbers and transfinite induction; variants of the Axiom of Choice.

MATH 170. Linear Programming. 3 Units
Prerequisite(s): MATH 31; MATH 35 or MATH 100.
Theory of linear programming, duality, simplex method, integer programming, applications.

MATH 190. History Of Mathematics. 3 Units
Prerequisite(s): MATH 31 and upper division status in mathematics.
Study of the development of mathematical ideas and techniques and their impact on the general course of the history of western civilization.

MATH 193. Capstone Course for the Teaching Credential Candidate. 3 Units
Prerequisite(s): Successful completion of at least five of the following: MATH 102, MATH 110A, MATH 110B, MATH 121, MATH 130A, MATH 130B or MATH 190; MATH 110A or MATH 130A may be taken concurrently.
Reviews the major themes presented in the upper division program in Mathematics, and relates the themes to junior high school and high school curriculum. Required for all subject matter students.
Note: Not accepted for credit for non-Teaching Credential students.

MATH 198. Seminar for Mathematics Tutors. 2 Units
Prerequisite(s): Students must be working as tutors in a campus-based program.
Supports Sacramento State students who are working in tutorial and related roles in mathematics programs on campus. Focus on questioning as a fundamental strategy for teaching mathematics, on classroom observation, and on communication among mathematics instructors in support of effective teaching and learning.
Note: May be repeated up to two times for credit.

Credit/No Credit

MATH 199. Special Problems. 1 - 6 Units
Individual projects or directed reading. Open only to those students who appear competent to carry on individual work. Admission to this course requires the approval of the faculty member under whom the individual work is to be conducted, in addition to the approval of the advisor and the Department Chair.
Credit/No Credit

MATH 210A. Algebraic Structures. 3 Units
Prerequisite(s): MATH 110B.
General algebraic systems and concepts; groups.

MATH 210B. Algebraic Structures. 3 Units
Prerequisite(s): MATH 210A.
Fields; vector spaces; Galois theory.

MATH 220A. Topology. 3 Units
Prerequisite(s): MATH 130B.
Point set topology, continuity, compactness, connectedness.

MATH 220B. Topics In Topology. 3 Units
Prerequisite(s): MATH 220A.
Continuation of MATH 220A with topics selected from: General topology/ Foundations, Geometric Topology, Continuum Theory, Homology Theory, Homotopy Theory, Topological Dynamics.
Note: May be taken twice with approval of the graduate coordinator.

MATH 230A. Real Analysis. 3 Units
Prerequisite(s): MATH 130B.
Metric topology; the theory of the derivative; measure theory.

MATH 230B. Real Analysis. 3 Units
Prerequisite(s): MATH 230A.
Continuation of MATH 230A, with topics selected from: Theory of the integral, including Riemann, Riemann Stieltjes, and Lebesque integrals.
Note: May be taken twice with approval of the graduate coordinator.

MATH 234A. Complex Analysis. 3 Units
Prerequisite(s): MATH 130B; MATH 105B or MATH 134 is recommended.
Complex numbers, complex functions, analytic functions, complex integration, harmonic functions.

MATH 234B. Topics in Complex Analysis. 3 Units
Prerequisite(s): MATH 234A.
Continuation of MATH 234A with topics selected from: Partial Fractions and Infinite Products, Entire Functions, Riemann Zeta Function, Normal Families, Riemann Mapping Theorem, Conformal Mapping of Polygons, Dirihclet Problem, Analytic Continuation.
Note: May be taken twice with approval of the graduate coordinator.

MATH 241A. Methods of Applied Mathematics. 3 Units
Prerequisite(s): MATH 134 recommended.
Topics from: Hilbert Space Theory, Operators on Hibert Space, Generalized Functions with Applications to Sturm-Liouville Theory and Partial Differential Equations.
Note: May be repeated for credit provided topic is not repeated.

MATH 241B. Topics in Applied Mathematics. 3 Units
Prerequisite(s): MATH 241A.
Continuation of MATH 241A with topics: Calculus of Variations, Functional Analysis, Dynamical Systems, Integral Equations, Sobolev Spaces, Fourier Analysis, Potential Theory, and Optimal Control Theory.
Note: May be taken twice with approval of the graduate coordinator.

MATH 299. Special Problems. 1 - 6 Units
Any properly qualified student who wishes to pursue a problem may do so if the proposed subject is acceptable to the supervising instructor and to the student's advisor.
Credit/No Credit

MATH 316. The Psychology of Mathematics Instruction. 2 Units
Prerequisite(s): Admission to the Mathematics Blended Program.
A survey course for students in the Blended Program in Mathematics that relates broad areas of educational psychology and theories of learning to instruction in the secondary mathematics classroom. The focus is on practical applications of theories through the design of lesson and unit plans. Students will design learning activities for diverse classes of learners, including English Language Learners, and build and refine assessment plans that include formative assessments. Lecture two hours.

MATH 371A. Schools and Community A. 2 Units
Corequisite(s): Enrollment in EDTE 470A.
The first of a two-part sequence supporting student teachers in the Mathematics Blended Program. Focus is on strategies for secondary mathematics instruction, the process of reflection on teaching, communication among mathematics teachers in support of effective teaching and learning, strategies for engagement, questioning, creating a safe classroom environment, classroom management, assessment, and familiarity with school and community resources. Emphasis on issues related to English Language Learners, special needs students, and intervention strategies. Seminar two hours.
Credit/No Credit

MATH 371B. Schools and Community B. 2 Units
Corequisite(s): Enrollment in EDTE 470B.
The second of a two-part sequence supporting student teachers in the Mathematics Blended Program. Focus is on strategies for secondary mathematics instruction, the process of reflection on teaching, communication among mathematics teachers in support of effective teaching and learning, strategies for engagement, questioning, creating a safe classroom environment, classroom management, assessment, and familiarity with school and community resources. Emphasis on issues related to English Language Learners, special needs students, and intervention strategies. Seminar two hours.
Credit/No Credit

MATH 500. Culminating Experience. 1 - 3 Units
Prerequisite(s): Advanced to candidacy and permission of the graduate coordinator.
Directed reading programs for master's candidates preparing for written comprehensive examinations.