

MATHEMATICS (MATH)

MATH 1. Mathematical Reasoning. 3 Units

General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)

Term Typically Offered: Fall, Spring, Summer

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 10. Essentials of Algebra. 3 Units

Prerequisite(s): Any valid score on ALEKS PPL exam

Term Typically Offered: Fall, Spring

Prepares students for courses requiring fundamental algebra skills. Topics include: review of basic algebra; scientific notation, rounding, and percents; factoring; exponents; linear equations and inequalities with applications; quadratic equations with applications; graphing with applications; absolute value equations and inequalities; systems of linear equations and inequalities; and an introduction to exponential and logarithmic expressions.

MATH 12. Algebra for College Students. 4 Units

Prerequisite(s): Score of 41 or higher on ALEKS PPL exam

Term Typically Offered: Fall, Spring

Prepares students for Pre-calculus and other higher math courses requiring intermediate algebra. Topics include: 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 & logarithmic properties and equations.

MATH 15H. Honors Mathematical Reasoning. 3 Units

Prerequisite(s): Open only to Honors students.

General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)

Term Typically Offered: Fall, Spring

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): Score of 46 or higher on ALEKS PPL exam or MATH 10

General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)

Term Typically Offered: Fall, Spring

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): Score of 51 or higher on ALEKS PPL exam or MATH 10

General Education Area/Graduation Requirement: Math Concepts &

Quantitative Reasoning (B4)

Term Typically Offered: Fall, Spring, Summer

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): Score of 61 or higher on ALEKS PPL exam or MATH 12

General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)

Term Typically Offered: Fall, Spring

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)

Term Typically Offered: Fall, Spring

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): Score of 61 or higher on ALEKS PPL exam or MATH 12

General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4)

Term Typically Offered: Fall, Spring

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): Score of 61 or higher on ALEKS PPL exam or MATH 12

Term Typically Offered: Fall only

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.

Term Typically Offered: Spring only

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.

<p>MATH 29L. Lab for Pre-Calculus Math A. 1 Unit Corequisite(s): MATH 29B. Term Typically Offered: Fall, Spring</p>	<p>MATH 32. Calculus III. 4 Units Prerequisite(s): MATH 31. Term Typically Offered: Fall, Spring, Summer</p>
<p>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</p>	<p>Continuation of Calculus II. Algebra and calculus of vectors; functions of several variables; partial differentiation; multiple integration; vector analysis.</p>
<p>MATH 29M. Lab for Pre-Calculus Math B. 1 Unit Corequisite(s): MATH 29B. Term Typically Offered: Fall, Spring</p>	<p>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) Term Typically Offered: Fall, Spring</p>
<p>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</p>	<p>Careful development of matrices, systems of equations, determinants, vector spaces, linear transformations, orthogonality, real and complex eigenvalues; \mathbb{R}^3 viewed as a vector space with generalization to \mathbb{R}^n.</p>
<p>MATH 30. Calculus I. 4 Units Prerequisite(s): Score of 76 or higher on ALEKS PPL exam or MATH 29 or MATH 29B General Education Area/Graduation Requirement: Math Concepts & Quantitative Reasoning (B4) Term Typically Offered: Fall, Spring</p>	<p>MATH 45. Differential Equations for Science and Engineering. 3 Units Prerequisite(s): MATH 31. Term Typically Offered: Fall, Spring, Summer</p> <p>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.</p>
<p>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.</p>	<p>MATH 99. Special Problems. 1 - 6 Units Term Typically Offered: Fall, Spring</p>
<p>MATH 30L. Laboratory for First Semester Calculus. 1 Unit Corequisite(s): Enrollment in a designated section of MATH 30. Term Typically Offered: Fall, Spring</p>	<p>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.</p>
<p>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</p>	<p>Credit/No Credit</p> <p>MATH 100. Applied Linear Algebra. 3 Units Prerequisite(s): MATH 26B or MATH 31. Term Typically Offered: Fall, Spring</p>
<p>Credit/No Credit</p>	<p>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.</p>
<p>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) Term Typically Offered: Fall, Spring, Summer</p>	<p>MATH 101. Combinatorics. 3 Units Prerequisite(s): MATH 31 Term Typically Offered: Spring only</p>
<p>MATH 30 continuation. Methods of integration; improper integrals; analytic geometry; infinite sequences and series.</p>	<p>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.</p>
<p>MATH 31L. Laboratory for Second Semester Calculus. 1 Unit Corequisite(s): Enrollment in a designated section of MATH 31. Term Typically Offered: Fall, Spring, Summer</p>	<p>MATH 102. Number Theory. 3 Units Prerequisite(s): MATH 31. Term Typically Offered: Fall, Spring</p>
<p>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</p>	<p>Theory of divisibility; some number theoretical functions; congruencies (linear and quadratic); some Diophantine equations. Simple continued fractions.</p>
<p>Credit/No Credit</p>	

<p>MATH 104. Vector Analysis. 3 Units Prerequisite(s): MATH 32. Term Typically Offered: Spring only</p> <p>Vector and scalar fields, integral theorems, orthogonal curvilinear coordinates, vector spaces and linear transformations, applications to physical fields and operators.</p>	<p>MATH 108. Introduction to Formal Mathematics. 3 Units Prerequisite(s): MATH 31, MATH 35. Term Typically Offered: Fall, Spring</p> <p>Logic of mathematical proof, set theory, relations, functions. Examples and applications from set cardinality, algebra, and analysis.</p>
<p>MATH 105A. Advanced Mathematics for Science and Engineering I. 4 Units Prerequisite(s): MATH 32, MATH 45. Term Typically Offered: Fall only</p> <p>Survey of second order linear differential equations, power series and Fourier series solutions, solution of partial differential equations by separation of variables.</p>	<p>MATH 110A. Modern Algebra. 3 Units Prerequisite(s): MATH 108. Term Typically Offered: Fall, Spring</p> <p>First half of a one-year introductory course in algebraic concepts. Topics include: groups, subgroups, properties of groups, permutation groups, factor groups, homomorphism theorems.</p>
<p>MATH 105B. Advanced Mathematics for Science and Engineering II. 4 Units Prerequisite(s): MATH 105A. Term Typically Offered: Spring only</p> <p>Partial differential equations continued, complex function theory and its applications.</p>	<p>MATH 110B. Modern Algebra. 3 Units Prerequisite(s): MATH 110A. Term Typically Offered: Fall, Spring</p> <p>Continuation of MATH 110A. Note: Topics include</p>
<p>MATH 107A. Fundamental Mathematical Concepts. 3 Units Prerequisite(s): MATH 17 and either a score of 46 or higher on ALEKS PPL exam or MATH 10 Term Typically Offered: Fall, Spring</p> <p>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.</p>	<p>MATH 117. Linear Algebra. 3 Units Prerequisite(s): MATH 110A. Term Typically Offered: Fall only</p> <p>Abstract linear spaces and linear transformations; invariant subspaces; canonical forms.</p>
<p>MATH 107B. Fundamental Mathematical Concepts. 3 Units Prerequisite(s): MATH 107A. Term Typically Offered: Fall, Spring</p> <p>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.</p>	<p>MATH 121. College Geometry. 3 Units Prerequisite(s): MATH 31; MATH 32 or MATH 35. Term Typically Offered: Fall, Spring</p> <p>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.</p>
<p>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. Term Typically Offered: Fall, Spring</p> <p>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?"</p>	<p>MATH 130A. Functions of a Real Variable. 3 Units Prerequisite(s): MATH 32 and MATH 108. Term Typically Offered: Fall, Spring</p> <p>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.</p>
	<p>MATH 130B. Functions of a Real Variable. 3 Units Prerequisite(s): MATH 130A. Term Typically Offered: Fall, Spring</p> <p>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.</p>
	<p>MATH 134. Functions of a Complex Variable and Applications. 3 Units Prerequisite(s): MATH 32. Term Typically Offered: Spring only</p> <p>Complex plane; analytic functions; integration and Cauchy's Theorem; sequences and series; residue calculus; applications to potential theory; Fourier and Laplace transforms.</p>

<p>MATH 150. Introduction to Numerical Analysis. 3 Units Prerequisite(s): MATH 31 Term Typically Offered: Spring only</p> <p>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.</p>	<p>MATH 198. Seminar for Mathematics Tutors. 2 Units Prerequisite(s): Students must be working as tutors in a campus-based program. Term Typically Offered: Fall, Spring</p> <p>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.</p> <p>Credit/No Credit</p>
<p>MATH 161. Mathematical Logic. 3 Units Prerequisite(s): MATH 108. Term Typically Offered: Fall, Spring</p> <p>Advanced study of logic with special application to mathematics.</p>	<p>MATH 199. Special Problems. 1 - 6 Units Term Typically Offered: Fall, Spring</p> <p>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</p>
<p>MATH 162. Set Theory. 3 Units Prerequisite(s): MATH 108. Term Typically Offered: Fall only</p> <p>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.</p>	<p>MATH 210A. Algebraic Structures. 3 Units Prerequisite(s): MATH 110B. Term Typically Offered: Fall, Spring</p> <p>General algebraic systems and concepts; groups.</p>
<p>MATH 170. Linear Programming. 3 Units Prerequisite(s): MATH 31; MATH 35 or MATH 100. Term Typically Offered: Fall only</p> <p>Theory of linear programming, duality, simplex method, integer programming, applications.</p>	<p>MATH 210B. Algebraic Structures. 3 Units Prerequisite(s): MATH 210A. Term Typically Offered: Fall, Spring</p> <p>Fields; vector spaces; Galois theory.</p>
<p>MATH 190. History Of Mathematics. 3 Units Prerequisite(s): MATH 31 and upper division status in mathematics. Term Typically Offered: Fall, Spring</p> <p>Study of the development of mathematical ideas and techniques and their impact on the general course of the history of western civilization.</p>	<p>MATH 220A. Topology. 3 Units Prerequisite(s): MATH 130B. Term Typically Offered: Fall, Spring</p> <p>Point set topology, continuity, compactness, connectedness.</p>
<p>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. Term Typically Offered: Spring only</p> <p>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.</p>	<p>MATH 220B. Topics In Topology. 3 Units Prerequisite(s): MATH 220A. Term Typically Offered: Fall, Spring</p> <p>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.</p>
<p>MATH 196K. Introduction to Differential Geometry. 3 Units Prerequisite(s): MATH 32, and MATH 35 or instructor's permission Term Typically Offered: Spring only</p> <p>Calculus methods are applied to the study of curves and surfaces in three dimensional space. After an introduction to the geometry of curves (curvature, torsion, and Frenet's formulas), the course explores the geometry of surfaces. Some of the geometrical properties of a surface that will be investigated are its first and second fundamental forms, its various curvatures (normal, principal, mean, and Gaussian curvatures), and its geodesic curves.</p>	<p>MATH 230A. Real Analysis. 3 Units Prerequisite(s): MATH 130B. Term Typically Offered: Fall, Spring</p> <p>Metric topology; the theory of the derivative; measure theory.</p>
	<p>MATH 230B. Real Analysis. 3 Units Prerequisite(s): MATH 230A. Term Typically Offered: Fall, Spring</p> <p>Continuation of MATH 230A, with topics selected from: Theory of the integral, including Riemann, Riemann Stieltjes, and Lebesgue integrals. Note: May be taken twice with approval of the graduate coordinator.</p>

- MATH 234A. Complex Analysis.** **3 Units**
Prerequisite(s): MATH 130B; MATH 105B or MATH 134 is recommended.
Term Typically Offered: Fall, Spring
- Complex numbers, complex functions, analytic functions, complex integration, harmonic functions.
- MATH 234B. Topics in Complex Analysis.** **3 Units**
Prerequisite(s): MATH 234A.
Term Typically Offered: Fall, Spring
- 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, Dirichlet 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.
Term Typically Offered: Fall, Spring
- Topics from: Hilbert Space Theory, Operators on Hilbert 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.
Term Typically Offered: Fall, Spring
- 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**
Term Typically Offered: Fall, Spring
- 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.
Term Typically Offered: Fall only
- 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.
Term Typically Offered: Fall, Spring
- 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.
Term Typically Offered: Fall, Spring
- 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.
Term Typically Offered: Fall, Spring
- Directed reading programs for master's candidates preparing for written comprehensive examinations.