# 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 24*AP. AP Meets MATH 24 + AREA B4.** 99 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, Summer  
Limits, differentiation with applications, integration and applications in the Social Sciences and Life Sciences.  

**MATH 26A. Calculus I 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 26B. Calculus II 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, Summer  
**MATH 29A. 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, Summer  
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 29B. Pre-Calculus Mathematics B.** 2 Units  
**Prerequisite(s):** MATH 29A.  
**Corequisite(s):** MATH 29M.  
**Term Typically Offered:** Fall, Spring, Summer  
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 29C. Pre-Calculus Mathematics C.** 2 Units  
**Prerequisite(s):** MATH 29B.  
**Corequisite(s):** MATH 29M.  
**Term Typically Offered:** Fall, Spring, Summer  
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 29D. Pre-Calculus Mathematics D.** 2 Units  
**Prerequisite(s):** MATH 29C.  
**Corequisite(s):** MATH 29M.  
**Term Typically Offered:** Fall, Spring, Summer  
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 29E. Pre-Calculus Mathematics E.** 2 Units  
**Prerequisite(s):** MATH 29D.  
**Corequisite(s):** MATH 29M.  
**Term Typically Offered:** Fall, Spring, Summer  
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 29F. Pre-Calculus Mathematics F.** 2 Units  
**Prerequisite(s):** MATH 29E.  
**Corequisite(s):** MATH 29M.  
**Term Typically Offered:** Fall, Spring, Summer  
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 29G. Pre-Calculus Mathematics G.** 2 Units  
**Prerequisite(s):** MATH 29F.  
**Corequisite(s):** MATH 29M.  
**Term Typically Offered:** Fall, Spring, Summer  
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 29H. Pre-Calculus Mathematics H.** 2 Units  
**Prerequisite(s):** MATH 29G.  
**Corequisite(s):** MATH 29M.  
**Term Typically Offered:** Fall, Spring, Summer  
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.
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<th>Course Code</th>
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<th>Corequisite(s)</th>
<th>Corequisite Notes</th>
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<td>MATH 29M</td>
<td>Lab for Pre-Calculus Math B.</td>
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<td>MATH 30</td>
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<td>Score of 76 or higher on ALEKS PPL exam or MATH 29 or MATH 29B</td>
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<td>MATH 26B</td>
<td>or MATH 31.</td>
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<td>MATH 31</td>
<td>Calculus II.</td>
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<td>MATH 30 or appropriate high school based AP credit.</td>
<td>Enrollment in a designated section of MATH 31</td>
<td>May not be taken for credit toward a mathematics major.</td>
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<td>Introduction to Linear Algebra.</td>
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<td>MATH 39</td>
<td>Special Problems.</td>
<td>1 - 6</td>
<td>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.</td>
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<td>MATH 100</td>
<td>Applied Linear Algebra.</td>
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**Corequisite(s):**
- Fall, Spring
- Fall, Spring, Summer

**Term Typically Offered:**
- Fall, Spring, Summer

**Credit/No Credit:**
- 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.

**Course Notes:**
- May not be taken for credit toward a mathematics major.
- 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.
- **Term Typically Offered:** Spring only
- 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.
- **Term Typically Offered:** Fall only

### MATH 105B. Advanced Mathematics for Science and Engineering II.
- **4 Units**
- **Prerequisite(s):** MATH 105A.
- **Term Typically Offered:** Spring only
- Partial differential equations continued, complex function theory and its applications.

### 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
- 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.
- **Term Typically Offered:** Fall, Spring
- 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.
- **Term Typically Offered:** Fall, Spring
- 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.
- **Term Typically Offered:** Fall, Spring
- 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.
- **Term Typically Offered:** Fall, Spring
- 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.
- **Term Typically Offered:** Fall, Spring
- Continuation of MATH 110A.
- **Note:** Topics include

### MATH 117. Linear Algebra.
- **3 Units**
- **Prerequisite(s):** MATH 110A.
- **Term Typically Offered:** Fall, Spring
- Abstract linear spaces and linear transformations; invariant subspaces; canonical forms.

### MATH 119. College Geometry.
- **3 Units**
- **Prerequisite(s):** MATH 31; MATH 32 or MATH 35.
- **Term Typically Offered:** Fall, Spring
- 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.
- **Term Typically Offered:** Fall, Spring
- 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.
- **Term Typically Offered:** Fall, Spring
- 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.
- **Term Typically Offered:** Spring only
- 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
Term Typically Offered: Spring only
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.
Term Typically Offered: Fall, Spring
Advanced study of logic with special application to mathematics.

MATH 162. Set Theory. 3 Units
Prerequisite(s): MATH 108.
Term Typically Offered: Fall only
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.
Term Typically Offered: Fall only
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.
Term Typically Offered: Fall, Spring
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.
Term Typically Offered: Fall, Spring
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 196K. Introduction to Differential Geometry. 3 Units
Prerequisite(s): MATH 32, and MATH 35 or instructor’s permission
Term Typically Offered: Spring only
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.

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
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
Term Typically Offered: Fall, Spring
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.
Term Typically Offered: Fall, Spring
General algebraic systems and concepts; groups.

MATH 210B. Algebraic Systems and Concepts. 3 Units
Prerequisite(s): MATH 210A.
Term Typically Offered: Fall, Spring
Fields; vector spaces; Galois theory.

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

MATH 220B. Topics in Topology. 3 Units
Prerequisite(s): MATH 220A.
Term Typically Offered: Fall, Spring
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.
Term Typically Offered: Fall, Spring
Metric topology; the theory of the derivative; measure theory.

MATH 230B. Real Analysis. 3 Units
Prerequisite(s): MATH 230A.
Term Typically Offered: Fall, Spring
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.
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
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.