

Mathematics

Andrew T. Parker, Associate Professor

Mathematics is a deductive science which studies pattern and structure with ideas grounded in numbers and shapes. The Mathematics Department at Principia College offers programs that lead to a Bachelor of Science in mathematics, a Bachelor of Arts in mathematics, and a minor in mathematics. The department also supports other departmental programs requiring mathematical training through various service courses.

The B.S. degree program prepares students for both graduate work in applied mathematics fields and careers in applied mathematics in industry. The B.A. degree program prepares students for graduate work in pure mathematics.

Mathematics majors must complete a core of required mathematics courses with a 2.000 grade point average or higher. This core consists of:

Code	Title	Semester Hours
MATH 181	Calculus I	4.0
MATH 182	Calculus II	4.0
MATH 220	Mathematical Proofs	2.0
MATH 273	Linear Algebra	3.0
MATH 283	Multivariable Calculus	4.0

The major programs differ in the required elective options and some required courses more appropriate to a particular degree program at the upper division level. Both major programs require a Senior Capstone course and a research paper written primarily in that course.

Independent study courses, such as combinatorics, can be arranged with the mathematics faculty.

Departmental Learning Outcomes

- 1. Students will be able to demonstrate knowledge of the foundational elements of undergraduate mathematics such as geometry, analysis, algebra, and logic.*
- 2. Students can solve problems appropriate for an undergraduate mathematics program.*
- 3. Students can synthesize proofs of theorems appropriate for an undergraduate mathematics program.*

Majors

- B.S. Major in Mathematics
- B.A. Major in Mathematics

Minor

- Minor in Mathematics

MATH 099 Basic Math Tutorial

0.0 SH

[]

A two-hour-per-week, non-credit guided tutorial for students needing review of arithmetic.

2 Mathematics

MATH 110 Mathematical Applications **3.0 SH** **<GEM>** **[GEQR]**

Applications of elementary mathematics in the fields of finance, economics, statistics, physical and life sciences, and business. Mathematical topics may include probability, decision trees, combinatorics, statistics, systems of linear equations, quadratic equations, population growth models, exponential decay, sequences and series, simple and compound interest investments, voting systems, basic trigonometry, laws of sines and cosines, astronomical models, and apportionment methods.

Prerequisite: Success in this course depends upon students having successfully completed the equivalent of two years of high school algebra and one year of high school geometry with grades of C or above.

Class Level Restriction: Freshman and Sophomore only.

MATH 111 A Survey of Mathematics **3.0 SH** **<GEM>** **[GEQR]**

A conceptual and historical overview of mathematics. A survey of selected topics such as: what mathematics is; numeration; elementary number theory; math and music; geometry and art; loans and payment plans; numbers, equations, and graphs; counting and probability; statistics; and geometric modeling. Intended for non-science majors.

Prerequisite: Success in this course depends upon students having successfully completed the equivalent of two years of high school algebra and one year of high school geometry with grades C or above.

Class Level Restriction: Freshman and Sophomore only.

MATH 140 Trigonometry **3.0 SH** **<GEM>** **[]**

Geometry review, angle measures, trigonometric functions - properties and graphs, trigonometric identities, inverse functions, trigonometric equations, solving general triangles. Possible additional topics: polar coordinates, spherical trigonometry, and hyperbolic trigonometry.

Prerequisite: High School Geometry and Intermediate Algebra. Success in this course depends upon students having completed a high school second-year algebra course and a high school geometry course with a grade of C or above.

MATH 141 College Algebra **3.0 SH** **<GEM>** **[]**

Topics include the theory of solving polynomial equations; solving simultaneous linear equations; graphs and properties of polynomial functions, rational functions, exponential functions, logarithmic functions, and conic sections; and mathematical induction and the general binomial expansion.

Prerequisite: Success in this course depends upon students having successfully completed the equivalent of two years of high school algebra and one year of high school geometry with grades of C or above.

MATH 143 Precalculus **4.0 SH** **<GEM>** **[]**

Investigates properties of functions, techniques for solving equations and inequalities and graphing. Emphasizes polynomial, rational, algebraic, exponential, logarithmic, and circular functions as well as conic sections and trigonometry.

Prerequisite: Success in this course depends upon students having successfully completed the equivalent of two years of high school algebra and one year of high school geometry with grades of C or above.

Class Level Restriction: Freshman and Sophomore only.

MATH 164 Introduction to Statistics **3.0 SH** **<GEM>** **[GEQR]**

Descriptive and inferential statistics established on principles of probability. Rules of probability; discrete and continuous random variables and common probability distributions; the Central Limit Theorem; estimation of central tendency and dispersion; hypothesis tests; linear regression and correlation. Applications drawn from a wide range of disciplines and industries.

Prerequisite: Success in this course depends upon students having successfully completed the equivalent of two years of high school algebra and one year of high school geometry with grades of C or above. (A student may receive credit for only one of the courses MATH 164 or BNR 215.).

MATH 181 Calculus I **4.0 SH** **<GEM>** **[]**

First semester of single-variable calculus. Includes a review of properties of elementary functions, limits, derivatives, applications of derivatives, continuity, the definite integral, basic antiderivative formulas, the Mean Value Theorem, and the Fundamental Theorem of Calculus.

Prerequisite: MATH 143.

MATH 182	Calculus II	4.0 SH	<GEM>	[]
<p>Second semester of single-variable calculus. Includes a review of Calculus I, techniques of integration, applications of the definite integral, an introduction to differential equations, parametric equations, polar coordinates, and the theory of infinite sequences and series, including tests for convergence and Taylor Series.</p> <p>Prerequisite: MATH 181.</p> <p>Class Level Restriction: Freshman and Sophomore only.</p>				
MATH 211	History of Mathematics	2.0 SH		[]
<p>A concise history of mathematics. Includes topics from mathematics in early civilizations, Greek mathematics from classical, first Alexandrian, and second Alexandrian periods, Hindu and Arabic contributions, European Renaissance, the calculus controversy, non-Euclidean geometry, the rise of analysis, Gödel's Incompleteness Theorem, and the loss of certainty.</p> <p>Prerequisite: MATH 181 or taken concurrently.</p>				
MATH 220	Mathematical Proofs	2.0 SH		[]
<p>Investigates the nature and structure of mathematical proofs found in calculus, algebra, and geometry. Includes set theoretic foundations, the rules of propositional logic, the principle of mathematical induction, and the nature of deductive reasoning. Analyzes various proofs from geometry, algebra, and calculus as well as provides students with practice in constructing such proofs.</p> <p>Prerequisite: MATH 182.</p>				
MATH 261	Discrete Math	3.0 SH	<GEM>	[]
<p>Nature of proof, sets, graph theory, logic, Boolean algebra, functions and relations.</p> <p>Prerequisite: MATH 143.</p>				
MATH 273	Linear Algebra	3.0 SH		[]
<p>Vector and matrix operations; systems of linear equations; determinants; vector spaces; linear transformations; inner product spaces; bases; eigenvalues; diagonalization. Additional topics and applications as time allows.</p> <p>Prerequisite: MATH 181.</p>				
MATH 283	Multivariable Calculus	4.0 SH		[]
<p>Includes vector algebra and coordinate geometry in two and three dimensions, partial differentiation, directional derivatives, slope fields, multiple integration and applications, line and surface integrals, Lagrange multipliers, vector calculus including Green's, Divergence, and Stokes' theorems.</p> <p>Prerequisite: MATH 182.</p>				
MATH 284	Differential Equations	3.0 SH		[]
<p>Linear differential equations; Laplace transform methods; series solutions; systems; numerical solutions; applications.</p> <p>Prerequisite: MATH 182. Recommended: MATH 283.</p>				
MATH 304	Synthetic Geometry	3.0 SH		[]
<p>An axiomatic development of Euclidean geometry using Hilbert's axioms; hyperbolic geometry and its models; a comparison of Euclidean, spherical, and hyperbolic trigonometry; may include an introduction to projective geometry.</p> <p>Prerequisite: MATH 273. Strongly recommended MATH 220.</p> <p>Class Level Restriction: Junior and Senior only.</p>				
MATH 320	Elementary Number Theory	3.0 SH		[]
<p>Divisibility theory of integers, primes and their distribution, theory of congruences, Fermat's "Little Theorem," Euler's phi function, quadratic reciprocity, perfect numbers and Mersenne primes, Fermat's "Last Theorem."</p> <p>Prerequisite: Strongly recommend MATH 220.</p> <p>Class Level Restriction: Junior and Senior only.</p>				

4 Mathematics

- MATH 355 Applied Advanced Calculus** **3.0 SH** []
Vector differential calculus, vector integral theorems, curvilinear coordinates. Fourier analysis: Fourier series, integrals, and transforms; orthogonal functions; applications in boundary value problems. Additional topics as time allows. Offered every other year.
Prerequisite: MATH 283.
Class Level Restriction: Junior and Senior only.
- MATH 360 Numerical Analysis** **3.0 SH** []
Theory and techniques for calculating numerical solutions to nonlinear problems. Root-finding; interpolation; approximation of functions and derivatives; numerical integration; applications. Error analysis emphasized throughout. Some prior programming experience is helpful but not assumed. Offered every other year.
Prerequisite: MATH 273 and MATH 283.
Class Level Restriction: Junior and Senior only.
- MATH 364 Mathematical Statistics** **3.0 SH** []
Calculus-based probability and statistics. Probability axioms and theorems; random variables; probability distributions; moments; moment generating functions; sampling distributions; Central Limit Theorem; estimation and hypothesis testing; correlation; linear and nonlinear regression; ANOVA.
Prerequisite: MATH 283.
Class Level Restriction: Junior and Senior only.
- MATH 370 General Topology** **3.0 SH** []
Introductory point-set topology. Topological spaces, open and closed sets, bases, interior, closure, limit points and boundary of subsets, metric spaces, continuous functions, homeomorphisms, connectedness and compactness, as well as some applications.
Prerequisite: MATH 182 and MATH 220.
Class Level Restriction: Junior and Senior only.
- MATH 374 Algebraic Structures** **3.0 SH** []
Group theory, Boolean algebra, rings, integral domains and fields. Offered every other year.
Prerequisite: MATH 220 and MATH 273.
Class Level Restriction: Junior and Senior only.
- MATH 415 Senior Capstone** **3.0 SH** []
Synthesizes and extends material from courses in the major using topics such as integration, linearity, optimization, periodicity, orthogonality, and expansions. Open only to mathematics majors.
Class Level Restriction: Senior only.
Field of Study Restrictions: Mathematics BA, Mathematics BS Majors only.
- MATH 421 Math Seminar** **1.0-3.0 SH** []
A seminar in selected topics in mathematics. The contents will vary, and the title will be extended to describe the current topic. May be taken more than once provided the topics differ.
Class Level Restriction: Junior and Senior only.
- MATH 431 Complex Variables** **3.0 SH** []
Analytical functions, Cauchy's theorem, Taylor and Laurent series, residues, contour integration, integral transforms, conformal mapping.
Prerequisite: MATH 283.
Class Level Restriction: Junior and Senior only.
- MATH 432 Real Analysis** **3.0 SH** []
Formal development of the concepts of real analysis. Includes limits and continuity, sequence and series, uniform convergence, Riemann integral.
Prerequisite: MATH 220 and MATH 283.
Class Level Restriction: Junior and Senior only.