

# MATHEMATICS

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Not all courses are offered every semester. Refer to the schedule of courses for each term's specific offerings.

More Info (<https://one.ufl.edu/soc/>)

*Unless otherwise indicated in the course description, all courses at the University of Florida are taught in English, with the exception of specific foreign language courses.*

## Department Information

Graduates from the Department of Mathematics might take a job that uses their math major in an area like statistics, biomathematics, operations research, actuarial science, mathematical modeling, cryptography, or mathematics education. Or they might continue into graduate school leading to a research career. Professional schools in business, law, and medicine appreciate mathematics majors because of the analytical and problem solving skills developed in the math courses.

**Website** (<https://math.ufl.edu/>)

### CONTACT

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Map (<http://campusmap.ufl.edu/#/index/0655>)

### Curriculum

- Combination Degrees
- Mathematics
- Mathematics Minor

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## About Precalculus and Calculus

A student can receive, at most:

- Four credits for MAC 1147 and MAC 1140
- Four credits for MAC 1147 and MAC 1114
- Five credits for MAC 1140 and MAC 1114
- Five credits for MAC 1147, MAC 1140, and MAC 1114
- If both MAC 2233 and MAC 2311 (or MAC 3472) are taken, credit will be given only for MAC 2311 (or MAC 3472).

## Courses

### MAA 4102 Introduction to Real Analysis 1 3 Credits

**Grading Scheme:** Letter Grade

Theory of real numbers, functions of one variable, sequences, limits, continuity and differentiation; continuity and differentiability of functions of several variables. Those who plan to do graduate work in mathematics should take MAA 4211. Credit will be given for, at most, one of MAA 4102, MAA 4211, or MAA 5104.

**Prerequisite:** (MAC 2313 or MAC 3474) and (MAS 4105 or MAS 3114) with minimum grades of C.

### MAA 4103 Introduction to Real Analysis 2 3 Credits

**Grading Scheme:** Letter Grade

Continues the advanced calculus for engineers and physical scientists sequence. Theory of integration, transcendental functions and infinite series. MAA 4102 is not recommended for those who plan to do graduate work in mathematics; these students should take MAA 4212. Credit will be given for, at most, one of MAA 4103, MAA 4212 and MAA 5105.

**Prerequisite:** MAA 4102 with minimum grade of C.

### MAA 4211 Real Analysis and Advanced Calculus 1 3 Credits

**Grading Scheme:** Letter Grade

Advanced treatment of limits, differentiation, integration and series. Includes calculus of functions of several variables. Credit will be given for, at most, one of MAA 4211, MAA 4102 and MAA 5104.

**Prerequisite:** MAS 4105 with minimum grade of B.

**MAA 4212 Real Analysis and Advanced Calculus 2 3 Credits****Grading Scheme:** Letter Grade

Continues the advanced calculus sequence in limits, differentiation, integration and series. Credit will be given for, at most, one of MAA 4212, MAA 4103 and MAA 5105.

**Prerequisite:** MAA 4211 with minimum grade of C, taken the previous semester.**MAA 4226 Introduction to Modern Analysis 1 3 Credits****Grading Scheme:** Letter Grade

Topology of metric spaces, numerical sequences and series, continuity, differentiation, the Riemann-Stieltjes integral, sequences and series of functions, the Stone-Weierstrass theorem, functions of several variables, Stokes' theorem and the Lebesgue theory. Credit will be given for, at most, MAA 4226 or MAA 5228.

**Prerequisite:** MAA 4212 with minimum grade of C.**MAA 4227 Introduction to Modern Analysis 2 3 Credits****Grading Scheme:** Letter Grade

Continues the modern analysis sequence discussing the topology of metric spaces, numerical sequences and series, continuity, differentiation, the Riemann-Stieltjes integral, sequences and series of functions, the Stone-Weierstrass theorem, functions of several variables, Stokes' theorem and the Lebesgue theory. Credit will be given for, at most, MAA 4227 or MAA 5229.

**Prerequisite:** MAA 4226 with minimum grade of C, taken the previous semester.**MAA 4402 Functions of a Complex Variable 3 Credits****Grading Scheme:** Letter Grade

Complex numbers, analytic functions, Cauchy-Riemann equations, harmonic functions, elementary functions, integration, Cauchy-Goursat theorem, Cauchy integral formula, infinite series, residues and poles, conformal mapping. Credit will be given for, at most, MAA 4402 or MAA 5404.

**Prerequisite:** (MAC 2313 or MAC 3474) and MAP 2302 with minimum grades of C.**MAC 1105 Basic College Algebra 3 Credits****Grading Scheme:** Letter Grade

Online entry-level algebra course for college students. (M)

**Prerequisite:** completion of the ALEKS placement exam.**Attributes:** General Education - Mathematics**MAC 1114 Trigonometry 2 Credits****Grading Scheme:** Letter Grade

Exponential and logarithmic functions, trigonometry and analytic and additional applications of trigonometry. (M)

**Attributes:** General Education - Mathematics**MAC 1140 Precalculus Algebra 3 Credits****Grading Scheme:** Letter Grade

College algebra, functions, coordinate geometry, exponential and logarithmic functions. (M)

**Prerequisite:** completion of the ALEKS placement exam.**Attributes:** General Education - Mathematics**MAC 1147 Precalculus Algebra and Trigonometry 4 Credits****Grading Scheme:** Letter Grade

College algebra, functions, coordinate geometry, exponential and logarithmic functions, and trigonometry. Fast-paced review of algebra and trigonometry to prepare for calculus. Assumes prior knowledge of intermediate algebra (Algebra 2) and trigonometry. (M)

**Prerequisite:** ALEKS  $\geq 61\%$ , if taken January 1, 2020 or later, or ALEKS  $\geq 50$ , if taken before January 1, 2020.**Attributes:** General Education - Mathematics**MAC 2233 Survey of Calculus 1 3 Credits****Grading Scheme:** Letter Grade

Geometric and heuristic approach to calculus; differentiation and integration of simple algebraic and exponential functions; applications to graphing, marginal analysis, optimization, areas and volumes. (M)

**Prerequisite:** Any of the following: minimal acceptable score on the online mathematics placement exam; a minimum grade of C in a MAC course numbered 1140 or higher; AP credit for MAC 2311; IB credit for a MAC course numbered 1140 or higher. Any course grades, AP or IB scores used to meet this prerequisite must be on file at UF by registration.**Attributes:** General Education - Mathematics**MAC 2234 Survey of Calculus 2 3 Credits****Grading Scheme:** Letter Grade

Sequences, geometric and Taylor series; systems of linear equations, Gaussian elimination, matrices, determinants and vectors; partial differentiation, multiple integrals; applications to marginal analysis, least-squares and Lagrange multipliers. (M)

**Prerequisite:** MAC 2233 with minimum grade of C, or the equivalent.**Attributes:** General Education - Mathematics

**MAC 2311 Analytic Geometry and Calculus 1 4 Credits****Grading Scheme:** Letter Grade

Introduces analytic geometry; limits; continuity; differentiation of algebraic, trigonometric, exponential and logarithmic functions; applications of the derivative; inverse trigonometric functions; differentials; introduction to integration; and the fundamental theorem of calculus. (M) Credit will be given for, at most, one of MAC 2233, MAC 2311 and MAC 3472.

**Prerequisite:** Any of the following: minimal acceptable score on the online mathematics placement exam; a grade of C in a MAC course numbered 1147 or higher; AP credit for MAC 2311; IB credit for a MAC course numbered 1147 or higher. Any course grades, AP or IB scores used to meet this prerequisite must be on file at UF by registration.

**Attributes:** General Education - Mathematics**MAC 2312 Analytic Geometry and Calculus 2 4 Credits****Grading Scheme:** Letter Grade

Techniques of integration; applications of integration; differentiation and integration of inverse trigonometric, exponential and logarithmic functions; sequences and series. (M) Credit will be given for, at most, one of MAC 2312, MAC 2512 and MAC 3473.

**Prerequisite:** MAC 2311 or MAC 3472 with a minimum grade of C.

**Attributes:** General Education - Mathematics**MAC 2313 Analytic Geometry and Calculus 3 4 Credits****Grading Scheme:** Letter Grade

Solid analytic geometry, vectors, partial derivatives and multiple integrals. (M) Credit will be given for, at most, MAC 2313 or MAC 3474.

**Prerequisite:** MAC 2312 or MAC 2512 or MAC 3473 with a minimum grade of C.

**Attributes:** General Education - Mathematics**MAC 3472 Honors Calculus 1 4 Credits****Grading Scheme:** Letter Grade

Topics covered in the MAC 3472/MAC 3473/MAC 3474 sequence closely parallel those covered in MAC 2311/MAC 2312/MAC 2313, but are treated in greater depth. Credit will be given for, at most, MAC 2311 or MAC 3472. (M)

**Prerequisite:** strong background in precalculus.

**Attributes:** General Education - Mathematics**MAC 3473 Honors Calculus 2 4 Credits****Grading Scheme:** Letter Grade

Continues the honors calculus sequence. (M) Credit will be given for, at most, one of MAC 2312, MAC 2512 and MAC 3473.

**Prerequisite:** MAC 3472 or MAC 2311 with a minimum grade of C.

**Attributes:** General Education - Mathematics**MAC 3474 Honors Calculus 3 4 Credits****Grading Scheme:** Letter Grade

Continues the honors calculus sequence. Credit will be given for, at most, MAC 2313 or MAC 3474.

**Prerequisite:** MAC 2312 or MAC 2512 or MAC 3473 with a minimum grade of C.

**MAD 2502 Intro to Computational Math 3 Credits****Grading Scheme:** Letter Grade

Introduces mathematical computation and the Python programming language. Emphasizes using mathematical algorithms to solve problems in analysis, number theory, combinatorics, algebra, linear algebra, numerical analysis, and probability.

**Prerequisite:** MAC 2311 or MAC 3472, minimum grade of C.

**MAD 3107 Discrete Mathematics 3 Credits****Grading Scheme:** Letter Grade

Logic, sets, functions; algorithms and complexity; integers and algorithms; mathematical reasoning and induction; counting principles; permutations and combinations; discrete probability. Advanced counting techniques and inclusion-exclusion.

**Prerequisite:** MAC 2312 or MAC 2512 or MAC 3473 with a minimum grade of C.

**MAD 4203 Introduction to Combinatorics 1 3 Credits****Grading Scheme:** Letter Grade

Permutations and combinations, binomial coefficients, inclusion-exclusion, recurrence relations, Fibonacci sequences, generating functions and graph theory.

**Prerequisite:** (MAC 2312 or MAC 2512 or MAC 3473) and (MAS 3300 or MHF 3202) with minimum grades of C.

**MAD 4204 Introduction to Combinatorics 2 3 Credits****Grading Scheme:** Letter Grade

Matching theory, block designs, finite projective planes and error-correcting codes. Does not require MAD 4203.

**Prerequisite:** (MAC 2312 or MAC 2512 or MAC 3473) and (MAS 3300 or MHF 3202) with minimum grades of C.

**MAD 4301 Graph Theory 3 Credits****Grading Scheme:** Letter Grade

Theory and applications of graphs including connectivity, planarity, coloration, algorithms, and network flow.

**Prerequisite:** MAS 3300 with a minimum grade of C or MHF 3202 with a minimum grade of C.

**MAD 4401 Introduction to Numerical Analysis 3 Credits****Grading Scheme:** Letter Grade

Numerical integration, nonlinear equations, linear and nonlinear systems of equations, differential equations and interpolation.

**Prerequisite:** MAS 3114 or MAS 4105 with a minimum grade of C and experience with a scientific programming language.**MAP 2302 Elementary Differential Equations 3 Credits****Grading Scheme:** Letter Grade

First-order ordinary differential equations, theory of linear ordinary differential equations, solution of linear ordinary differential equations with constant coefficients, the Laplace transform and its application to solving linear ordinary differential equations. (M)

**Prerequisite:** MAC 2312 or MAC 2512 or MAC 3473 with a minimum grade of C.**Attributes:** General Education - Mathematics**MAP 4102 Probability Theory and Stochastic Processes 2 3 Credits****Grading Scheme:** Letter Grade

Random walks and Poisson processes, martingales, Markov chains, Brownian motion, stochastic integrals and Ito's formula.

**Prerequisite:** STA 4321 with a minimum grade of C.**MAP 4305 Differential Equations for Engineers and Physical Scientists 3 Credits****Grading Scheme:** Letter Grade

The second course in differential equations. Topics include systems of linear differential equations, stability theory and phase plane analysis, power series solutions of differential equations, Sturm-Liouville boundary-value problems and special functions. Credit will be given for, at most, MAP 4305 or MAP 5304.

**Prerequisite:** MAP 2302 and (MAS 3114 or MAS 4105 or EGM 3344) with minimum grades of C.**MAP 4341 Elements of Partial Differential Equations 3 Credits****Grading Scheme:** Letter Grade

Introduces second-order linear partial differential equations (heat, wave and Laplace equations), separation of variables in PDEs, Sturm-Liouville eigenvalue problems, method of eigenfunction expansions (Fourier analysis) and Green's functions. Possible introduction to first-order PDEs and the method of characteristics. Credit will be given for, at most, MAP 4341 or MAP 5345.

**Prerequisite:** MAP 2302 and MAP 4305 with minimum grades of C.**MAP 4413 Fourier Analysis 3 Credits****Grading Scheme:** Letter Grade

Introduces linear systems and transforms; Laplace, Fourier and Z transforms and their mutual relationship; convolutions. Operational calculus; computational methods including the fast Fourier transform; second-order stationary processes and their autocorrelation functions; and problems of interpolation, extrapolation, filtering and smoothing of second-order stationary processes.

**Prerequisite:** (MAC 2313 or MAC 3474) and MAP 2302 and (MAS 3114 or MAS 4105) with minimum grades of C.**MAP 4484 Modeling in Mathematical Biology 3 Credits****Grading Scheme:** Letter Grade

Mathematical models of biological systems. Topics include models of growth, predator-prey populations, competition, the chemostat, epidemics, excitable systems and analytical tools such as linearization, phase-plane analysis, Poincaré–Bendixson theory, Lyapunov functions and bifurcation analysis.

**Prerequisite:** MAP 2302 and (MAS 3114 or MAS 4105) with minimum grades of C.**MAS 3114 Computational Linear Algebra 3 Credits****Grading Scheme:** Letter Grade

Linear equations, matrices and determinants. Vector spaces and linear transformations. Inner products and eigenvalues. Emphasizes computational aspects of linear algebra.

**Prerequisite:** MAC 2312, MAC 2512 or MAC 3473 with a minimum grade of C and experience with a scientific programming language.**MAS 4105 Linear Algebra 1 4 Credits****Grading Scheme:** Letter Grade

Linear equations, matrices, vector spaces, linear transformations, determinants, eigenvalues and inner-product spaces. Includes both theory and computational skills. Develops the ability to reason through, and coherently write, proofs of theorems. For math majors, this course serves as a transition from a study of techniques into more conceptual math; for engineering and science majors, it serves also as a coherent foundation in linear algebra.

**Prerequisite:** (MAC 2313 or MAC 3474) and (MAS 3300 or MHF 3202) with minimum grades of C.**MAS 4115 Linear Algebra for Data Science 3 Credits****Grading Scheme:** Letter Grade

A second course in linear algebra, focusing on topics that are the most essential for data science. Introduces theory and numerical methods required for large data-sets and machine learning. Topics include LU, QR, and singular-value decompositions; conditioning and stability; the DFT and filters; deep learning; fully connected and convolutional nets.

**Prerequisite:** (MAS 3114 or MAS 4105) and MAC 2313.

**MAS 4203 Introduction to Number Theory 3 Credits****Grading Scheme:** Letter Grade

Introduces elementary number theory and its applications to computer science and cryptology. Divisibility, primes, Euclidean Algorithm, congruences, Chinese Remainder Theorem, Euler-Fermat Theorem and primitive roots. Selected applications to decimal fractions, continued fractions, computer file storage and hashing functions, and public-key cryptography.

**Prerequisite:** MAC 2312 and (MAC 2512 or MAC 3473) with a minimum grade of C; MAS 3300 recommended.**MAS 4301 Abstract Algebra 1 3 Credits****Grading Scheme:** Letter Grade

Sets and mappings, groups and subgroups, homomorphisms and isomorphisms, permutations, rings and domains, arithmetic properties of domains, and fields. Requires facility in writing proofs.

**Prerequisite:** (MAS 3300 or MHF 3202 with a minimum grade of B) or MAS 4105 with a minimum grade of C.**MAS 4302 Abstract Algebra 2 3 Credits****Grading Scheme:** Letter Grade

A second course in Abstract Algebra, focusing on Galois Theory, the algebraic theory of fields and polynomial equations. Introduces concepts of abstract algebra used in settling famous historical problems including the problems of angle trisection and duplication of cubes by ruler and compass constructions, and the insolubility of polynomial equations of the fifth degree by radicals.

**Prerequisite:** MAS 4301.**MAT 3503 Functions and Modeling 3 Credits****Grading Scheme:** Letter Grade

Group activities strengthen knowledge of secondary mathematics, especially topics from precalculus and the transition to calculus, including contexts that can be modeled using linear, exponential, polynomial or trigonometric functions. Topics include conic sections, parametric equations and polar equations. Explorations involve multiple representations, transformations and data analysis techniques, and are facilitated by various technologies.

**Prerequisite:** MAC 2311 and UFTeach Step 1.**Corequisite:** MAC 2312.**MAT 4905 Individual Work 1-3 Credits****Grading Scheme:** Letter Grade

Special topics not obtainable in regular course offerings.

**Prerequisite:** MAC 2313 or MAC 3474 with a minimum grade of C and undergraduate coordinator permission.**MAT 4911 Undergraduate Research in Mathematics 0-3 Credits****Grading Scheme:** Letter Grade

Provides firsthand, supervised research in mathematics. Projects may involve inquiry, design, investigation, scholarship, discovery or application in mathematics.

**MAT 4930 Special Topics in Mathematics 1-3 Credits****Grading Scheme:** Letter Grade

Qualified undergraduates take part in seminars or classes on special topics.

**Prerequisite:** undergraduate coordinator permission.**MAT 4956 Overseas Studies 1-15 Credits****Grading Scheme:** Letter Grade

Provides a mechanism by which coursework taken as part of an approved study abroad program can be recorded on the UF transcript and counted toward graduation.

**Prerequisite:** undergraduate advisor permission.**MGF 1106 Mathematics for Liberal Arts Majors 1 3 Credits****Grading Scheme:** Letter Grade

For non-science and non-business majors. Includes an introduction to set theory, logic, number theory, probability, statistics, graphing, and linear programming.

**Attributes:** General Education - Mathematics**MGF 1107 Mathematics for Liberal Arts Majors 2 3 Credits****Grading Scheme:** Letter Grade

Demonstrates the beauty and utility of mathematics through topics which include financial management, linear and exponential growth, mathematics in the arts, and discrete mathematics. Does not require MGF 1106.

**Attributes:** General Education - Mathematics**MHF 3202 Sets and Logic 3 Credits****Grading Scheme:** Letter Grade

Examples of sets, operations on sets, set algebra, Venn diagrams, truth tables, tautologies, applications to mathematical arguments, and mathematical induction. Can also be very useful for prospective and in-service secondary and middle school teachers. Taking one, but not both, of MAS 3300 or MHF 3202 is required of mathematics majors.

**Prerequisite:** MAC 2312 with a minimum grade of C.

**MHF 4102 Elements of Set Theory 3 Credits**

**Grading Scheme:** Letter Grade

Basic axioms and concepts of set theory. Students present proofs. Credit will be given for, at most, MHF 4102 or MHF 5107.

**Prerequisite:** MAS 4105 with a minimum grade of C.

**MHF 4203 Foundations of Mathematics 3 Credits**

**Grading Scheme:** Letter Grade

Models and proofs. Foundations of real and natural numbers, algorithms, Turing machines, undecidability and independence. Examples and applications in algebra, analysis, geometry and topology. Credit will be given for, at most, MHF 4203 or MHF 5207.

**Prerequisite:** MAS 4105 with a minimum grade of C.

**MTG 3212 Geometry 3 Credits**

**Grading Scheme:** Letter Grade

Axiomatic treatment of topics in Euclidean, non-Euclidean, projective geometry and (time permitting) fractal geometry. Particularly useful for prospective secondary-school mathematics teachers.

**Prerequisite:** MAC 2312 and (MAC 2512 or MAC 3473 with a minimum grade of C).

**MTG 4302 Elements of Topology 1 3 Credits**

**Grading Scheme:** Letter Grade

Basic concepts of general topology. Credit will be given for, at most, MTG 4302 or MTG 5316.

**Prerequisite:** MAS 4105 with a minimum grade of C.

**MTG 4303 Elements of Topology 2 3 Credits**

**Grading Scheme:** Letter Grade

Continues the basic concepts of general topology. Credit will be given for, at most, MTG 4303 or MTG 5317.

**Prerequisite:** MTG 4302 with a minimum grade of C.

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