

MATHEMATICS

www.mcla.edu/math (<http://www.mcla.edu/math/>)

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Mathematics Major

The Department of Mathematics offers a four-year program leading to a Bachelor of Science in mathematics. The program fosters insights and solutions to a variety of problems through symbolic and numerical analysis. The practice of the discipline requires and engenders precise modes of thinking. The use of calculus, numerical methods, probability, statistics, and logic is basic to the quantitative methods needed throughout society today.

Students graduating with a major in Mathematics will be able to:

- Perform computations and procedures from a wide range of the various branches of mathematics;
- Demonstrate mathematical growth by acquiring a solid grasp of key concepts and themes;
- Develop fluency in reading and constructing mathematical proofs;
- Apply mathematical ideas and problem-solving to real-life situations in the various disciplines.

Mathematics Programs

- Mathematics - Mathematics Education Concentration, B.S. (<https://catalog.mcla.edu/undergraduate/academic-programs-study/mathematics/mathematics-major-concentration-mathematics-education/>)
- Mathematics Minor (<https://catalog.mcla.edu/undergraduate/academic-programs-study/mathematics/mathematics-minor/>)
- Mathematics, B.S. (<https://catalog.mcla.edu/undergraduate/academic-programs-study/mathematics/mathematics-major/>)

Mathematics Courses

MATH 100 Math for Educators I

3 cr

Reviews key concepts in numbers, operations, and algebra. Examines proofs and explanations suitable for elementary instruction. Covers: number bases other than ten, the order of operations, and the addition, subtraction, multiplication, and division of integers, fractions, and algebraic expressions.

MATH 101 Math for Educators II

3 cr

Reviews key concepts in functions, algebra, and geometry. Examines proofs and explanations suitable for elementary instruction. Covers: decimals, percents, exponents, radicals, functions, sequences, equations, dimensional analysis, and basic geometry, including angles, areas, volumes, and basic proofs.

Prerequisite: MATH 100

MATH 102 Mathematics for Liberal Arts

3 cr

Presents mathematics topics designed to promote mathematical problem solving, reasoning, decision making and communication. Students will develop an understanding of the nature, purposes and accomplishments of mathematics. Topics selected from elementary set theory, logic, number theory, graph theory, voting theory, functions, difference equations and geometry.

Attributes: Quantitative Reasoning (CMA)

MATH 150 Precalculus

3 cr

Introduces topics necessary for the study of calculus. A detailed study of algebraic, trigonometric, exponential and logarithmic functions and equations, and their applications to modeling real world problems. Topics are considered from analytical, graphical and numerical points of view.

Prerequisite: Placement based on SAT scores and high school background

Attributes: Quantitative Reasoning (CMA)

MATH 201 Math Modeling for Educators

3 cr

Explores the tools necessary to create and adapt mathematical modelling projects suitable for K-12 mathematics students. Reviews current best practices in assessment and transparency, with a focus on writing and coding in mathematics. Students will create a final modelling project suitable for direct inclusion in a classroom setting, with lesson plans, assignment templates, rubrics, and plans for giving appropriate support and feedback.

MATH 220 Calculus I

3 cr

Examines limits, continuity, the derivative, differentiation of elementary functions, applications of the derivative and an introduction to the antiderivative. The first of a four-part sequence.

Prerequisite: MATH 150, placement based on SAT and high school background or department approval

Attributes: Quantitative Reasoning (CMA)

MATH 230 Calling Bullshit

3 cr

Teaches students how to recognize persuasion, trickery, or lies that show a blatant disregard for facts and the truth - in a word bullshit. Because it is not enough in today's world to simply recognize bullshit when it appears in its myriad forms, students will also learn how to counter bullshit in powerful and persuasive ways, enhancing not only their own information literacy in the process, but that of people they encounter when they call bullshit.

MATH 232 Introduction to Statistics

3 cr

Examines descriptive statistics, probability, sampling theory and inferential statistics. Mathematics majors cannot use this course for credit towards their major.

Attributes: Quantitative Reasoning (CMA)

MATH 232H Honors: Introduction to Statistics

3 cr

Examines descriptive statistics, probability, sampling theory and inferential statistics. Mathematics majors cannot use this course for credit towards their major.

Attributes: Quantitative Reasoning (CMA), Honors Program (HONR)

MATH 240 Proof I

3 cr

Introduces sets, Boolean logic, combinatorics, functions, and the basics of mathematical proof.

Prerequisite: Completion of Tier I Quantitative Reasoning or instructor approval

MATH 250 Discrete Mathematics	3 cr	MATH 332 Probability and Statistics II	3 cr
Provides a foundation in mathematical topics central to the study of computer science, emphasizing mathematical reasoning and algorithms. Topics include propositional logic, Boolean algebra, mathematical proofs and induction, computer arithmetic, elementary combinatorics, recursion, graphs and trees, matrices, sequences and summation.		Examines functions of random variables, sampling distribution, limit theorems, estimation, hypotheses testing, linear regression, correlation, analysis of variance and analysis of enumerative data.	
MATH 261 Linear Algebra	3 cr	MATH 340 Graph Theory	3 cr
Investigates the theory of vector spaces, linear equations, linear transformations, determinants, inner product spaces, eigenvalues and eigenvectors.		Investigates definitions and examples of graphs, graph isomorphism, paths and circuits, connectivity, trees, planar graphs, Euler's formula, graph coloring, four and five color theorems and applications.	
Prerequisite: MATH 240		Prerequisite: MATH 240	
MATH 270 Statistics and Data Analysis	4 cr	MATH 340H Honors: Graph Theory	3 cr
Examines descriptive statistics, probability, discrete and continuous random variables, confidence intervals, hypothesis testing, analysis of variance, regression and correlation. Includes normal distribution, t-distribution, chi square distribution. Required computer programming laboratory.		Investigates definitions and examples of graphs, graph isomorphism, paths and circuits, connectivity, trees, planar graphs, Euler's formula, graph coloring, four and five color theorems and applications.	
Corequisite: MATH 270L		Prerequisite: MATH 240	
Attributes: Quantitative Reasoning (CMA)		Attributes: Honors Program (HONR)	
MATH 286 Topics in Mathematics	1-4 cr	MATH 344 Geometry	3 cr
Examines sophomore level topics in mathematics that complement departmental offerings in mathematics or math competency courses. Emphasis is on the nature of mathematical thought and applications of mathematics.		Studies geometries from an advanced standpoint. Some of the topics that may be covered are non-Euclidean geometry, geometry of the complex plane, affine geometry or projective geometry.	
Prerequisite: Completion of Tier I Quantitative Reasoning or instructor approval		Prerequisite: MATH 310	
Repeatable: Unlimited Credits		MATH 345 Game Theory	3 cr
MATH 301 Math for Middle and High School Educators	3 cr	Introduces game theory terminology, zero-sum, two-person games, minimax theorem, optimal mixed strategies and applications to economics.	
Provides in-depth explanations for the mathematics taught in middle and high school: algebra, equations, and functions. Covers methods for providing differentiated instruction - reviewing topics from arithmetic (fractions, numbers, and operations) while simultaneously introducing new topics.		Prerequisite: MATH 261	
Prerequisite: Completion of Tier I Quantitative Reasoning		MATH 360 Number Theory	3 cr
MATH 310 Proof II	3 cr	Introduces the basic concepts of number theory: the Euclidean algorithm, primes, divisibility theorems, Mersenne and Fermat numbers, linear Diophantine equations, congruences, unique factorization and quadratic reciprocity.	
Examines a wide variety of proof techniques (e.g. direct, by contradiction, by contrapositive, bi-directional, uniqueness, by induction, by counter-example). Students will practice these techniques and learn how and when to apply each one. Functions and relations will provide many examples, and be covered in-depth.		Prerequisite: MATH 310 or concurrent enrollment in MATH 310	
Prerequisite: MATH 240		MATH 362 Abstract Algebra	3 cr
MATH 320 Calculus II	3 cr	Introduces the study of algebraic structures with a detailed examination of groups, their properties, and their mappings, including both isomorphic and homomorphic mappings. Cyclic, symmetric, and quotient groups will be studied, as well as groups of permutations, cosets, and normal subgroups. Also covers the Fundamental Homomorphism Theorem.	
Studies antiderivatives, the definite integral, transcendental functions, techniques and applications of integration, an introduction to improper integrals. The second of a four-part sequence.		Prerequisite: MATH 310	
Prerequisite: MATH 220		MATH 365 Mathematical Modeling	3 cr
MATH 330 Calculus III	3 cr	Explores the development of mathematical models that solve different types of problems, including both discrete and continuous real-world problems that are either deterministic or probabilistic. Determines solutions analytically and through the use of mathematical software.	
Studies infinite series, plane curves, polar coordinates, vectors, vector-valued functions and analytic geometry in three-dimensional space. The third of a four-part sequence.		Prerequisite: MATH 320 and either MATH 270 or CSCI 120 or other programming course	
Prerequisite: MATH 320		MATH 372 History of Mathematics	3 cr
MATH 331 Probability and Statistics I	3 cr	Examines the historical development of mathematics and its impact from ancient to modern times.	
Examines probability laws, discrete and continuous random variables and their probability distributions, expectation, moments and moment generating functions, sequences of random variables and Markov chains.		Prerequisite: MATH 320	
Prerequisite: MATH 430 or concurrent enrollment in MATH 430, and MATH 270		MATH 380 Differential Equations	3 cr
		Examines first- and second-order differential equations with particular emphasis on nth order equations with constant coefficients, differential operators, systems of equations, series solutions, and Laplace transforms.	
		Prerequisite: MATH 330	

MATH 390 Numerical Analysis

Studies the approximation of polynomials at points and over intervals; numerical solutions of algebraic and transcendental equations in one unknown using geometric and arithmetic methods; numerical differentiation; and integration.

Prerequisite: MATH 330 and either MATH 270 or CSCI 120 or other programming course

3 cr**MATH 430 Calculus IV**

Concludes the four-semester sequence of calculus with the study of functions in two or more variables, their derivatives and partial derivatives, multiple integrals, line and surface integrals, Green's Theorem and Stoke's Theorem.

Prerequisite: MATH 330

3 cr**MATH 440 Topology**

Covers various topological spaces. Continuity, connectedness, and compactness are analyzed and compared. Applications of continuity will be applied to the contraction mapping principle. Analysis of product spaces and quotient spaces. Alternate topics may be discussed.

Prerequisite: MATH 310

3 cr**MATH 444 Operations Research**

Covers various interrelated topics such as linear programming, network analysis, game theory, probability and queuing theory, and optimization theory.

Prerequisite: MATH 430

3 cr**MATH 455 Complex Variables**

Studies the basic theory of functions of a complex variable including complex numbers and their algebra; analytic functions; Cauchy-Riemann conditions; and the differential and integral calculus of analytic functions.

Prerequisite: MATH 430

3 cr**MATH 460 Real Analysis**

Examines the basis of calculus with a rigorous exploration of the function concept from both a set-theoretic and topological viewpoint with particular attention to the completeness of the real number system, limits, continuity and convergence of sequences and series.

Prerequisite: MATH 310, MATH 330

3 cr**MATH 465 Financial Mathematics**

Introduces the concepts of probability theory: discrete and continuous random variables, and their probability distributions. Covers Brownian motions and geometric Brownian motion, the binomial model, the Black-Scholes formula; the markets for futures, options, and other derivatives. Discusses the mechanics of trading, pricing, hedging, and managing risk using derivatives.

Prerequisite: MATH 320

3 cr**MATH 486 Special Topics in Mathematics**

Introduces theory that is an extension of various upper-division mathematics courses. Special topics may explore, but are not restricted to: analysis, geometry and theory related to modern technology.

Prerequisite: To be determined by the instructor

Repeatable: Unlimited Credits

1-4 cr**MATH 500 Independent Study**

Open to juniors and seniors who wish to read in a given area or to study a topic in depth. Written reports and frequent conferences with the advisor are required.

Prerequisite: Junior/senior status, department approval

Repeatable: Maximum of 12 credits

1-3 cr**MATH 540 Internship in Mathematics****1-15 cr**

Qualified students may be placed as interns in mathematically oriented positions. The internship is designed to supplement and apply classroom study.

Prerequisite: Junior/senior status, department approval

Repeatable: Maximum of 15 credits

MATHEMATICS: TEACHER LICENSURE

Students majoring in mathematics may choose to pursue initial teacher licensure as an early childhood teacher or elementary teacher. Also, mathematics majors may pursue initial licensure as a teacher of mathematics for the middle school or secondary levels. Students seeking any of these licenses must complete a mathematics major and a licensure program in education.