

# MATHEMATICS (MA)

## MA 106. College Algebra Corequisite. 0 Credits.

This course provides corequisite support for students needing supplemental instruction while taking MA 107. Content will parallel and expand the topics studied in MA 107. The course meets two hours per week. Students in MA 107 with a math placement score of 1 are required to take this course. Students in MA 107 with a math placement score of 2 may choose to enroll in this course.

**Corequisites:** Take MA 107.

**Offered:** Every year, Fall and Spring

## MA 107. College Algebra. 3 Credits.

This course reviews the fundamentals of algebra. Students learn about the following topics: the real number system, factoring and expanding polynomials, properties of logarithms and exponentials, linear equations and inequalities, quadratic equations and inequalities, absolute value equations and inequalities, systems of equations and inequalities, functions and their graphs, and algebra of functions, including composition, and inverse functions. This course is designed for students who need to improve their algebraic skills to prepare for future mathematics courses such as Applied Calculus, Pre-Calculus, or Statistics. MA 107 does not fulfill the Quantitative Literacy requirement.

**Corequisites:** Requires placement score of 2, 3 or a score of 1 and Coreq of MA 106

**Offered:** Every year, All

## MA 109. Contemporary Mathematics Corequisite. 0 Credits.

This course provides corequisite support for students needing supplemental instruction while taking MA 110. Content will parallel and expand the topics studied in MA 110. The course meets two hours per week. Students in MA 110 with a math placement score of 1 are required to take this course. Students in MA 110 with a math placement score of 2 may choose to enroll in this course.

**Corequisites:** Take MA 110

**Offered:** Every year, Spring

## MA 110. Contemporary Mathematics. 3 Credits.

This course introduces students to the study of mathematics as a discipline and also presents topics that are applicable to students' everyday lives. Topics include logic, probability and statistics and financial mathematics. The course also covers two topics from the following list: geometry, set theory, number theory, measurement, problem solving, mathematical systems, scientific applications, history of mathematics. Topics are chosen by the instructor. Students should check the mathematics requirements for their major before selecting their first course in mathematics. MA 110 is not designed to be a prerequisite for any calculus course.

**Corequisites:** Requires placement score of 2+ or a score of 1 and Coreq of MA 109

**Offered:** Every year, All

**UC:** Breadth Elective

## MA 140. Pre-Calculus. 3 Credits.

This course concentrates on topics that students need to understand profoundly to succeed in calculus. Students learn about the following topics: functions and their graphs, exponents and logarithms and trigonometry. There is a focus on basic concepts and visualization of problems. The material has many real-life applications. Use of a TI-83 or TI-84 calculator is required.

**Prerequisites:** Take MA 107; Minimum grade C- or placement level of 3.

**Offered:** Every year, All

**UC:** Breadth Elective

## MA 140H. Pre-Calculus. 3 Credits.

This course concentrates on topics that students need to understand profoundly to succeed in calculus. Students learn about the following topics: functions and their graphs, exponents and logarithms and trigonometry. There is a focus on basic concepts and visualization of problems. The material has many real-life applications. Use of a TI-83 or TI-84 calculator is required.

**Prerequisites:** Take MA 107; Minimum grade C- or placement level of 3.

**Offered:** Every year, All

**UC:** Breadth Elective

## MA 141. Calculus of a Single Variable. 3 Credits.

This course covers functions, graphs, limits, continuity, derivatives, applications of derivatives, antiderivatives and definite integrals, as well as the Fundamental Theorem of Calculus. This course significantly advances the following Essential Learning Outcomes: quantitative reasoning, critical thinking and reasoning. Many sections require a TI-83/84 calculator (or the equivalent); check with the instructor. Students cannot receive credit for both MA 141 and MA 151.

**Prerequisites:** Take MA 140; Requires placement score of 5 or take MA 140 or MA 140H. Minimum C grade required.

**Offered:** Every year, All

**UC:** Breadth Elective

## MA 141H. Honors Calculus of a Single Variable. 3 Credits.

This course covers functions, graphs, limits, continuity, derivatives, applications of derivatives, antiderivatives and definite integrals, as well as the Fundamental Theorem of Calculus. This course significantly advances the following Essential Learning Outcomes: quantitative reasoning, critical thinking and reasoning. Many sections require a TI-83/84 calculator (or the equivalent); check with the instructor. Students cannot receive credit for both MA 141 and MA 151.

**Prerequisites:** Take MA 140; Requires placement score of 5 or take MA 140 or MA 140H. Minimum C grade required.

**Offered:** Every year, Fall

**UC:** Breadth Elective

## MA 150. Integral Calculus With Applications. 1 Credit.

This course provides a bridge from MA 141 to MA 152 or from MA 141 to MA 153. This course covers numerical integration and applications of integration. A graphing calculator is required; the TI-83 or TI-84 is recommended.

**Prerequisites:** Take MA 141 or MA 141H. Minimum grade C-.

**Offered:** Every year, Fall and Spring

## MA 151. Calculus I. 4 Credits.

This course covers functions and graphs, limits and continuity, derivatives, applications of derivatives, antiderivatives and definite integrals, the Fundamental Theorem of Calculus, numerical integration and applications of definite integrals. A graphing calculator is required; the TI-83 or TI-84 is recommended. Students cannot receive credit for both MA 151 and MA 141.

**Prerequisites:** Take MA 140; Minimum grade C; or placement level of 5.

**Offered:** Every year, All

**UC:** Breadth Elective

## MA 152. Calculus II. 4 Credits.

This course covers techniques of integration, improper integrals, differential equations, infinite series, parametric equations, polar coordinates, vectors, operations on vectors, and three-dimensional coordinate systems.

**Prerequisites:** Take MA 151 or MA 141 or MA 141H; Minimum grade C-.

**Corequisites:** Take MA 150.

**Offered:** As needed

- MA 153. Calculus II: Part A.** **2 Credits.**  
The first part of Calculus II focuses on methods and applications of integration. Topics include definite and indefinite integrals, techniques of integration, numerical integration, differential equations, improper integrals. Offered the first half of each semester.  
**Prerequisites:** Take MA 141 or MA 141H or MA 151. Minimum grade C-.  
**Offered:** Every year, All
- MA 154. Calculus II: Part B.** **2 Credits.**  
The second part of Calculus II covers sequences and series, convergence tests, power series, Taylor series parametric equations, polar coordinates, and conic sections.  
**Prerequisites:** Take MA 153. Minimum grade C-.  
**Offered:** Every year, All
- MA 169. Probability and Data Analysis Corequisite.** **0 Credits.**  
This course provides corequisite support for students needing supplemental instruction while taking MA 170. Content will parallel and expand the topics studied in MA 170. The course meets two hours per week. Students in MA 170 with a math placement score of 1 are required to take this course. Students in MA 170 with a math placement score of 2 may choose to enroll in this course.  
**Corequisites:** Take MA 170.  
**Offered:** Every year, Spring
- MA 170. Probability and Data Analysis.** **3 Credits.**  
This course teaches students the fundamentals of probability and solves real-life probability problems. Students learn to use graphical techniques and descriptive statistics to analyze data. Topics include: ratios, proportions, percentages, empirical and theoretical probability calculations, conditional probability and independence, Bayes' Theorem, expected value, discrete probability distributions, continuous probability distributions, descriptive statistics for central tendency and variability, graphical techniques including histograms and scatter diagrams, and analyzing data sets. The course also includes an introduction to Excel and prepares students for future courses in statistics and analytics. Students cannot receive credit for MA 170 and MA 176. Math placement level 2 or corequisite of MA 169 required to register for course.  
**Corequisites:** Requires placement score of 2+ or a score of 1 and Coreq of MA 169  
**Offered:** Every year, All  
**UC:** Breadth Elective
- MA 176. Baseball and Statistics.** **3 Credits.**  
This course covers Sabermetrics: the use of standard statistical topics to analyze data derived from baseball records. The book, "Moneyball," is read to understand how Billy Beane used statistics to bring success to the Oakland Athletics. The standard statistical topics covered include exploratory data analysis, elementary probability, discrete probability distributions, normal probability distributions, sampling distributions, regression and correlation. Learning to use Excel to do statistical analysis is an integral part of the course. Students must possess a basic knowledge of baseball. Students cannot receive credit for MA 170 and MA 176. Math placement level 2 required for course registration.  
**Prerequisites:** Placement level 2.  
**Offered:** Every year, Fall and Spring  
**UC:** Breadth Elective
- MA 190. Mathematics 1st Year Seminar.** **1 Credit.**  
This course presents excursions into a variety of areas in advanced mathematics, as well as its applications, history and philosophy. Students also explore career options related to the study of mathematics.  
**Prerequisites:** Take MA 140 MA 141 MA 141H or MA 151; Grade of C- or better.  
**Offered:** Every year, Spring
- MA 200. Special Topics in Mathematics.** **3 Credits.**  
The course explores special topics in mathematics or statistics  
**Prerequisites:** Varies by topic.  
**Offered:** As needed, All
- MA 205. Introduction to Discrete Mathematics (CSC 205).** **3 Credits.**  
This course introduces students to basic concepts and structures of discrete mathematics. Topics can include propositional and predicate logic, sets and set operations, functions, proof techniques, counting problems, probability and basic number theory. Applications include computer science, biology, social sciences, law and the physical sciences.  
**Prerequisites:** Take CSC 110 or MA 110 or higher; Minimum grade C-.  
**Offered:** Every year, Spring
- MA 206. Statistics for the Behavioral Sciences.** **3 Credits.**  
This course presents a study of statistical procedures pertinent to the work of the social and behavioral scientist. Students are introduced to descriptive procedures, confidence intervals, hypothesis testing, regression and correlation, analysis of variance and non-parametric techniques. Students are not allowed to receive credit for more than one of the following courses: MA 206, MA 275 and MA 285.  
**Prerequisites:** Take MA 107, MA 140, MA 141 MA 151, MA 170, or MA 176. Minimum grade C-; or placement level of 3 or higher.  
**Offered:** Every year, All
- MA 229. Linear Algebra.** **3 Credits.**  
This course covers the basic concepts of linear algebra, along with an introduction to the language and techniques of formal mathematics. Topics include systems of linear equations, vector spaces, linear transformations, matrices, determinants and eigenvalues.  
**Prerequisites:** Must have a math placement score of 4 or 5, or have taken MA 110 or MA 140.  
**Offered:** Every year, Spring
- MA 251. Calculus III.** **4 Credits.**  
This course covers vectors and multivariable calculus. Topics include analytic geometry of space, vector-valued functions with applications, differentiation and integration of multivariable functions with applications, integration in vector fields including line and surface integrals, and Green's, Stokes's, and the Divergence Theorems.  
**Prerequisites:** Take MA 152 or MA 153 and MA 154; Minimum grade C-.  
**Offered:** Every year, Fall and Spring
- MA 265. Matrix Algebra and Differential Equations.** **4 Credits.**  
This course covers the basic concepts of both linear algebra and ordinary differential equations with an emphasis on applications in science and engineering. Linear algebra topics include systems of linear equations, vector spaces and subspaces, linear transformations, matrix algebra, determinants and eigenvalues. Differential equation topics include solutions to first, second and higher order homogeneous and nonhomogeneous differential equations. Solution methods include use of eigenvalues and eigenvectors, Laplace transforms, infinite series and numerical approximations. Special differential equations including Legendre, Bessel, Hermite and Chebyshev equations also are discussed as well as transformations for autonomous equations. A graphing calculator is recommended (TI-83 or TI-84) as well as knowledge of Excel. Students cannot receive credit for both MA 265 and MA 365.  
**Prerequisites:** Take MA 152 or MA 153; Minimum grade C-.  
**Offered:** Every year, Spring

- MA 275. Biostatistics.** **3 Credits.**  
Students are introduced to the application of statistical techniques to the biological and health sciences with emphasis on probability laws, sampling and parameter estimation, central limit theorem, test of hypothesis, correlation, regression and analysis of variance. Students are not allowed to receive credit for more than one of the following courses: MA 206, MA 275 and MA 285.  
**Prerequisites:** Take MA 107, MA 170, MA 176, MA 140, MA 141, or MA 151. Or have a placement score of 4 or higher.  
**Offered:** Every year, All
- MA 275H. Honors Biostatistics.** **3 Credits.**  
Students are introduced to the application of statistical techniques to the biological and health sciences with emphasis on probability laws, sampling and parameter estimation, central limit theorem, test of hypothesis, correlation, regression and analysis of variance.  
**Prerequisites:** Take MA 107, or MA 170, or MA 176, or MA 140; Minimum grade C- or placement level of 4.  
**Offered:** As needed
- MA 280. Applied Stats in Theory and Practice.** **1 Credit.**  
This course presents and reinforces content that is present in MA 285 but may be missing or described with less mathematical rigor in MA 275, EC 272, and PS 206. The content focuses on implementing statistical methods in R or a similar programming language, integrating theoretical concepts in probability and mathematical statistics with applied interpretations of results, and applications of calculus to probability and statistics.  
**Prerequisites:** Take MA 275 or EC 272 or PS 206 and MA 141 or MA 151  
**Offered:** Every year, Spring
- MA 285. Applied Statistics.** **3 Credits.**  
This introductory statistics course is intended primarily for students majoring in engineering, mathematics or the sciences. Emphasis is on using statistics to answer questions in the physical and social sciences. Topics include descriptive statistics, probability, point and interval estimation, hypothesis testing, correlation and regression, analysis of variance, chi-square tests and nonparametric methods. Students will implement statistical methods in R or a similar programming language. Students are not allowed to receive credit for more than one of the following courses: MA 206, MA 275 and MA 285.  
**Prerequisites:** Take MA 141 or MA 141H or MA 151; Minimum grade C-.  
**Offered:** Every year, Fall and Spring
- MA 299. Independent Study in Mathematics.** **1-6 Credits.**  
This individual study in a specialized area is open to juniors and seniors by special arrangement with the department chairperson. This is a structured program of reading, problem solving and experiments established through conferences with a member of the mathematics faculty. Graded by examination or term project.  
**Prerequisites:** None  
**Offered:** Every year, All
- MA 300. Special Topics.** **3 Credits.**  
This course explores special topics in mathematics or statistics.  
**Corequisites:** Varies by topic  
**Offered:** As needed
- MA 301. Foundations of Advanced Mathematics.** **3 Credits.**  
This course is an exploration of the language and nature of mathematics. Emphasis is placed on developing the students' ability to construct and write mathematical proofs and helping students read and understand mathematical reasoning. Various techniques of proof are discussed, including direct, contrapositive, induction, contradiction and counterexample. Mathematical content includes elementary logic, quantifiers, set theory, relations, functions and number systems. Other topics are at the instructor's discretion, and may include number theory, graph theory, point-set topology or counting problems.  
**Prerequisites:** Take MA 229 or MA 205; Minimum grade C-.  
**Offered:** Every year, Fall
- MA 305. Discrete Mathematics.** **3 Credits.**  
Students study various topics in discrete mathematics, such as proof by induction, recurrence relations, cardinality of a set, the pigeonhole principle, counting techniques, probability and graph theory.  
**Prerequisites:** Take MA 301 or CSC 205; Minimum grade C-.  
**Offered:** Every other year, Fall
- MA 315. Theory of Computation.** **3 Credits.**  
This course provides an introduction to the classical theory of computer science with the aim of developing a mathematical understanding of the nature of computing by trying to answer one overarching question: "What are the fundamental capabilities and limitations of computers?" Specific topics include finite automata and formal languages (How do we define a model of computation?), computability (What can be computed? and How do we prove something cannot be computed?) and complexity (What makes some problems so much harder than others to solve? and What is the P versus NP question and why is it important?).  
**Prerequisites:** Take MA 301 or CSC 215; Minimum grade C-.  
**Offered:** Every other year, Spring
- MA 318. Cryptography.** **3 Credits.**  
Students study methods of transmitting information securely in the face of a malicious adversary deliberately trying to read or alter it. Participants also discuss various possible attacks on these communications. Students learn about classical private-key systems, the Data Encryption Standard (DES), the RSA public-key algorithm, discrete logarithms, hash functions and digital signatures. Additional topics may include the Advanced Encryption Standard (AES), digital cash, games, zero-knowledge techniques and information theory, as well as topics chosen by the students together with the instructor for presentations.  
**Prerequisites:** Take MA 229 or CSC 215. Minimum grade C-.  
**Offered:** Every other year, Spring
- MA 321. Abstract Algebra.** **3 Credits.**  
This course presents a study of topics selected from groups, normal groups, rings, ideals, integral domains, fields, polynomial rings and isomorphism theorems.  
**Prerequisites:** Take MA 229, and MA 301; Minimum grade C-.  
**Offered:** Every year, Spring
- MA 341. Advanced Calculus.** **3 Credits.**  
The concepts of limit, continuity, differentiation and Riemann integration are studied in depth. Also considered are sequences and series, improper integrals, and Riemann-Stieltjes Integral.  
**Prerequisites:** Take MA 152 or MA 153; and MA 301 Minimum grade C-.  
**Offered:** Every year, Fall

**MA 351. Real Analysis.****3 Credits.**

This course examines the theoretic foundations of continuity, differentiation and integration at a more abstract level than MA 341. The class reinforces and further expands on proof techniques covered in MA 301. Topics include: convergence of sequences and series, construction of the real number system, metric spaces, dense sets, continuity, compactness, connectedness, differentiation, Riemann-Stieltjes Integral and sequences of functions. Students who wish to pursue graduate studies in mathematics are strongly encouraged to take this class. It is recommended that students take MA 341 before attempting this class.

**Prerequisites:** Take MA 142 or MA 152 or MA 154 and MA 301; Minimum grade C-.

**Offered:** As needed

**MA 365. Ordinary Differential Equations.****3 Credits.**

Students are introduced to standard methods for solving ordinary differential equations, including Laplace transforms as well as singular solutions, series solutions and the system of linear differential equations. Existence and uniqueness theorems also are introduced, as are geometrical interpretation and applications. Students cannot receive credit for both MA 265 and MA 365.

**Prerequisites:** Take MA 152 or MA 154; and MA 229; Minimum grade C-.

**Offered:** Every other year, Fall

**MA 370. Number Theory.****3 Credits.**

Topics include representation of integers, primes, the Fundamental Theorem of Arithmetic, divisibility, modular arithmetic, Fermat's Little Theorem and Euler's Theorem, perfect numbers, and Diophantine equations. Additional topics may include quadratic residues, sums of squares, and Fermat's Last Theorem.

**Prerequisites:** take 1 course; from subject MA; from level 300; Minimum grade C-.

**Offered:** Every other year, Spring

**MA 371. Mathematical Statistics and Probability I.****3 Credits.**

This course covers foundations of probability, random variables and select probability distributions with applications. Topics include sample spaces and events; conditional probability; independence; expected value, variance and other moments; joint densities; and probability distributions including the normal, Poisson, Binomial and other distributions.

**Prerequisites:** Take MA 153 Minimum grade C-.

**Offered:** Every Third Year, Fall

**MA 372. Mathematical Statistics and Probability II.****3 Credits.**

Students are introduced to general principles of estimation and testing hypotheses; small sample distributions; regression and correlation; design of experiments and analysis of variance; nonparametric techniques; and other methods.

**Prerequisites:** Take MA 371; Minimum grade C-.

**Offered:** Every Third Year, Spring

**MA 378. Mathematical Modeling.****3 Credits.**

Students develop mathematical models for problems in biology, environment, health sciences and politics.

**Prerequisites:** Take MA 141, or MA 141H, or MA 151; and MA 229; Minimum grade C-.

**Offered:** Every other year, Fall

**MA 399. Independent Study in Mathematics.****1-6 Credits.**

This individual study in a specialized area is open to juniors and seniors by special arrangement with the department chairman. This is a structured program of reading, problem solving and experiments established through conferences with a member of the mathematics faculty. Graded by examination or term project.

**Prerequisites:** None

**Offered:** As needed

**MA 490. Mathematics Senior Seminar.****3 Credits.**

Students work on a senior-level project, culminating in a written and oral report. This course counts as the university's Integrative Capstone requirement for Mathematics majors and is for senior mathematics majors only.

**Prerequisites:** Must have standing as a senior mathematics major.

**Offered:** Every year, Spring

**MA 499. Independent Study in Mathematics.****1-6 Credits.**

This individual study in a specialized area is open to juniors and seniors by special arrangement with the department chairman. This is a structured program of reading, problem solving and experiments established through conferences with a member of the mathematics faculty. Graded by examination or term project.

**Prerequisites:** None

**Offered:** As needed