

MA: Courses in Mathematics

Department of Mathematics, Engineering, and Computer Science

MA 105 Introduction to Contemporary Mathematical Applications 3 Cr

A course for students with varied mathematical interests and backgrounds. Stresses applications of contemporary mathematics in modern society. Topics include management science, statistics, social choice, patterns, population sizes, and computers. Emphasizes conceptual understanding and appreciation. This course satisfies the Carroll College Core Curriculum for mathematics, but not as a statistics requirement. Prerequisite: Intermediate Algebra. Spring semester.

MA 112 Precalculus: Functions and Graphs 3 Cr

A comprehensive study of elementary functions to prepare students for a college course in calculus. Topics include a review of intermediate algebra including the solution of equations and inequalities, and an in-depth look at functions, inverse functions, their graphs, symmetries, asymptotes, intercepts, and transformations. Linear, polynomial, rational, radical, exponential, logarithmic, and trigonometric functions are studied, and graphing calculators are used extensively. Prerequisite: Mathematics preparation at least through Intermediate Algebra. Spring semester.

MA 117 Difference Equations and Linear Algebra 3Cr

Introductory college mathematics course in finite difference equations and linear algebra. Topics include sequences, differences, linear and nonlinear difference equations, systems of difference equations, numerical solutions of linear and nonlinear equations, and analytical techniques for solving linear systems using linear algebra. Applications from many fields are studied and the role of mathematical modeling is a central focus. Formal computer labs are a part of the course each week, with spreadsheets being the primary software employed. This course satisfies a Carroll College Core Curriculum for all students and the mathematics requirement for business majors. Prerequisite: three years of high school mathematics through Intermediate Algebra. Each semester.

MA 121 Differential Calculus 3 Cr

This is the first of a two-semester, six-credit calculus sequence. We begin the first semester by reviewing functions from several perspectives (symbolic, numeric, and graphic). For most of the course we study differential calculus, emphasizing how we can use calculus to understand real-world problems such as police radar detection, laying an oil pipeline around a swamp, and understanding motion. We use computers and calculators extensively, and we also focus on learning how to explain mathematics verbally and in writing. The sequence MA 121-MA 122 is considered to be equivalent to MA 131. Prerequisite: Four years of high school mathematics including precalculus.

MA 122 Integral Calculus 3 Cr

This is the second of a two-semester, six-credit calculus sequence. In this course we study topics in integral calculus, emphasizing how we can use calculus to understand real-world problems such as fluid pumping and lifting, how rain catchers are used in city drain systems, and how a compound bow fires an arrow. We use computers and calculators extensively, and we also focus on learning how to explain mathematics verbally and in writing. The sequence MA 121-MA 122 is considered to be equivalent to MA 131. Prerequisite: A grade of C or better in MA 121.

MA 131 Calculus of Single Variable Functions 4 Cr

This course covers all aspects of single-variable calculus including derivatives, antiderivatives, definite integrals, and the fundamental theorem of calculus. We highlight how we can use calculus to understand real-world problems such as laying an oil pipeline around a swamp, fluid pumping and lifting, and how rain catchers are used in city drain systems. We use computers and calculators extensively, meeting in the computer lab once each week. We also focus on learning how to explain mathematics verbally and in writing. This is the same material that is covered in MA 121-122, except this is an accelerated course that does not review precalculus material. Prerequisite: Previous calculus experience or strong precalculus background. Fall semester.

MA 201 Mathematics for Elementary Education I 3 Cr

A course primarily for prospective elementary teachers, designed to give a background in logic, set theory, the set of integers and their properties, the system of rational numbers, and real numbers as an extension of the rationals. Prerequisite: Intermediate Algebra. Fall semester.

MA 202 Mathematics for Elementary Education II 3 Cr

An extension of MA 201 into geometry and measurement, functions and their graphs, and a brief introduction to probability and statistics. Special emphasis will be given to the development of skills in problem-solving and to applications. Prerequisite: MA 201. Spring semester.

MA 207 Elementary Statistics 3 Cr

The basic concepts used in statistics such as measures of central tendency, variation, probability distributions, and statistical inference are stressed. Applications are made in the social, communication, health, biological, and physical sciences. This course does not count toward a major or minor in mathematics. Prerequisites: Intermediate Algebra. Each semester.

MA 232 Differential Equations & Linear Algebra I 4 Cr

This course is an introduction to difference equations, differential equations, and linear algebra. Specific topics include analytical and numerical solutions to difference equations and first-order linear differential equations, phase line analysis, stability of equilibrium, matrix equations and eigenvalues. We emphasize how this mathematics can be used on many real-world problems such as how to predict the spread of a disease, how a home mortgage works, and how to understand the growth of animal populations. We use computers and calculators extensively, meeting in the computer lab once each week. We also focus on learning how to explain mathematics verbally and in writing. Prerequisite: A grade of C or better in MA 131 or in MA 122. Spring semester.

MA 233 Multivariable Calculus 4 Cr

In this course we study multivariable and vector calculus including vectors, parametric equations, surfaces, partial differentiation, multiple integrals, and vector calculus. The big spotlight in this course is using these ideas to understand things like force fields, the flow of water, and magnetic fields. Once a week we meet in the computer lab to use the power of computers to focus on the visual aspects of these concepts to gain insight into more complex situations. We also focus on learning how to explain mathematics verbally and in writing. Prerequisite: A grade of C or better in MA 131 or in MA 122. Fall semester.

MA 301 Foundations of Mathematics 3 Cr

An examination of logic, sets, functions, and methods of proof as a foundation for the study of mathematics. Other topics covered include mathematical induction, recursive definitions, relations (equivalence relations), elementary number theory, transforma-

tional geometry, and some history of mathematics. Prerequisite: Grade of “C” or better in MA 233. Spring semester.

MA 328 Modern Applications of Discrete Mathematics 3 Cr
A look at some actual applications of discrete mathematics that emphasize such unifying themes as mathematical reasoning, algorithmic thinking, modeling, combinatorial analysis, the kinds of structures used in discrete mathematics, and the use of technology. Possible topics include cryptography, primes and factoring, computer passwords, networking problems, shortest paths, scheduling problems, building circuits, modeling computation, and correctness of algorithms. Three (3) one-hour class periods with a substantial computing component illustrating the technology and the ideas studied. Prerequisite: Grades of “C” or better in MA 131 or MA 121-122. Fall semester.

MA 334 Differential Equations & Linear Algebra II 4 Cr
In this course, we focus on both systems of differential equations, with special attention given to modeling, linearization, and equilibrium analysis; as well as the mathematical language of systems – linear algebra, especially transformations and vector spaces. We will motivate the material through applications such as population models, structural, and electrical systems, and linear algebra applications such as 3-D imaging, Markov processes, and Leslie matrices. Technology will again play a major role in this course, as we will have frequent computer demonstrations in class and weekly computer labs to explore the quantitative aspects of these topics. You will have the opportunity to explore topics beyond the textbook on a series of group projects throughout the semester. Prerequisite: A grade of C or better in MA 232. Spring semester.

MA 336 Probability and Statistics I 2 Cr
This course is a calculus-based introduction to basic concepts in probability and statistics. Topics in probability include: probability of simple and compound events; an introduction to discrete and continuous random variables including the uniform, binomial, and normal distributions, and random event simulation. Topics in statistics include statistical measures and graphs and simple linear regression. We begin to learn how to perform statistical analysis on data sets and draw appropriate conclusions based on their analysis. Prerequisite: A grade of C or better in MA 131 or in MA 122. Spring semester.

MA 341 Probability and Statistics II 3 Cr
A calculus-based course in applied probability and statistics. Many types of univariate and multivariate probability distributions are derived and applications are studied. Exposes the student to various decision-making techniques when working with statistical information. Students also gain experience with statistical computing software. Prerequisite: A grade of “C” or better in MA 336. Fall semester. Fulfills writing intensive requirement.

MA 342 Numerical Computing and Visualization 3 Cr
In this course we study the basic numerical methods used by computers to solve a wide variety of problems, emphasizing how we can use graphics to understand how things work. We focus not just on how these methods work, but when they are appropriate, where they fail, and how to interpret their results. This course is designed around a series of open-ended projects based on real-world problems, such as how to predict the price of heating oil, testing rocket orbital trajectories, and studying the flow of heat throughout a building. The topics we study include least squares regression methods, interpolation, curve fitting, and the numerical solution of a wide range of differential equations (both ODEs and PDEs). Prerequisite: A grade of “C” or better in MA 334.

Spring semester. This course satisfies the mathematics writing intensive requirement.

MA 366 Junior Seminar 1 Cr
This is a one-credit, pass/fail, seminar-style course. There will be three main segments: select a faculty director for either an honors thesis or a senior project and write a research proposal, write a resume and research job opportunities, and write a graduate school essay and research graduate school opportunities. The overall goal of this course is to prepare students for their senior year and beyond. This course should be taken in the spring of the year before intended graduation (typically in the spring of the junior year). Spring semester annually.

MA 401 Modern Algebra and Applied Geometry 3 Cr
This course covers the traditional topics from abstract algebra, including groups, rings, integral domains, fields, and homomorphic and isomorphic relationships, as well as standard topics from geometry, including axiomatic systems in both Euclidean and Non-Euclidean geometries and transformational geometry with vectors and matrices. The focus for the class is the contemporary applications of the concepts presented, together with the weaving together of geometric and algebraic themes. Linear algebra is the integrating theme. Prerequisites: Grade of “C” or better in MA 301.

MA/CS 403 Introduction to Modern Cryptography 4 Cr
This course is intended to be an introduction to the essential core areas of modern cryptography. We begin with a look at historical cryptography and then move into more modern concepts. Mathematical background is provided as needed and informal descriptions of the cryptosystems along with more precise pseudo-code descriptions are given. Algorithms and systems will be illustrated with many examples, and their mathematical underpinnings carefully explained. Because of the heavy use of mathematics made in this course (number theory, discrete mathematics, probability, linear algebra and probably some calculus), this course is cross-listed and may be taken either for mathematics or computer science credit. The course is lab-based with each lab illustrating cryptosystems and concepts studied in class. Prerequisites: Grades of “C” or better in MA 131 or MA 122 and MA 328. Fall semester.

MA 421 Mathematical Optimization, Applications, and Analysis 3 Cr
This course is a project-based exploration of topics in optimization and mathematical programming, such as linear, integer, nonlinear, and stochastic programming. We explore the modeling, algorithmic and heuristic solution approaches to, and sensitivity analysis of problems such as the Knapsack problem, Traveling Salesman problem, and the Ising spin glass problem. Computers and technology will again play an important role as we investigate both the implementation and the theoretical basis of solution techniques. This course will bring together topics from single and multivariable calculus, linear algebra, and probability. Prerequisite: Grades of C or better in MA 334 and in MA 336. Fall semester.

MA 471 History Seminar in Mathematics 1 Cr
This course in the history of mathematics is intended to give students an insight into some of the great masterpieces of mathematics, as seen in their historical contexts. Developing an understanding of the individuals who were the creators of mathematics helps one better appreciate their creations. Since mathematics is an ever-growing discipline in which new ideas are built upon the old, half the semester is dedicated to 20th century developments in mathematics. Required course for mathematics secondary-education majors. Offered when demand is sufficient.