

## 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: Elementary 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 Algebra II. Each semester.

#### MA 121 Calculus I 3 Cr

A first course in calculus for the student of the social, behavioral, and life sciences. A review of functions using multiple representations (symbolic, numeric, and graphic) is followed by an applications-oriented study of the derivative, mathematical modeling, and finite difference equations. Emphasis is on the use of technology to solve real-world problems. Fall semester.

#### MA 122 Calculus II 3 Cr

A continuation of MA 121 to the integral calculus. Methods of integration, with strong emphasis on applications to economics, physics, geometry, and biology. Differential equations and Taylor series are introduced. Prerequisite: MA 121. Spring semester.

#### MA 123 Introduction to Difference Equations 1 Cr

This class consists of a brief study of discrete dynamical systems, also known as difference equations. Spreadsheets and calculators are used to analyze differences for familiar functions and relate them to derivatives. Difference equations representing relationships are constructed and solved numerically and analytically where appropriate, with solutions analyzed in terms of stable or unstable equilibrium points. This is a one-credit course, offered only on a Pass/Fail basis. It serves as a transition for students

moving from MA 121 to MA 232 at the semester. It is intended only for students who are changing their major at the semester, usually from biology to chemistry, engineering, mathematics or computer science. Fall semester (second half) at the discretion of the department. Prerequisite: current enrollment in MA 121 and consent of instructor.

#### MA 131 Calculus, Difference, and Differential Equations 4 Cr

This is the first in a series of four, one-semester, integrated mathematics courses. The focus in the first semester is on finite difference equations in dynamical systems, derivatives and antiderivatives, and an introduction to differential equations including phase line analysis, and stability of equilibrium. There is a heavy emphasis on applications, modeling, engineering design, and problem solving techniques. Computers and calculators are used extensively. Each student is required to have a specified calculator, and the class meets once a week in the computer laboratory. Reading, writing, and verbal skills in mathematics are also developed. Students are assigned to work collaboratively on projects, to prepare written reports, and to make presentations to the class. Some problems and projects may require students to address social, cultural, or aesthetic issues in science and technology. Required for all mathematics, engineering, computer science, and chemistry majors. 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: Elementary 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. Prerequisites: Sophomore or above standing required. Elementary Algebra. Each semester.

#### MA 232 Calculus, Linear Algebra, and Differential Equations 4 Cr

This is the second in a series of four, one-semester, integrated mathematics courses. The focus in the second semester is on definite integrals and the fundamental theorem of calculus, difference and differential equations with an introduction to systems, an introduction to optimization, distributions, and an introduction to linear algebra to include the eigenvalue problem. There is a heavy emphasis on applications, modeling, engineering design concepts, and problem solving techniques. Reading, writing, and verbal skill in mathematics are also developed. Some problems and projects may require students to address social, cultural, or aesthetic issues in science and technology. Computers and calculators are used extensively. Required for all mathematics, engineering, computer science, and chemistry majors. Spring semester. Prerequisite: MA 131.

**MA 233      Multivariable Calculus      4 Cr**

This is the third in a series of four, one-semester integrated mathematics courses. This course focuses on vectors, parametric equations, surfaces, partial differentiation, multiple integrals, vector calculus, and linear algebra. Computer labs using *Mathematica* are a fundamental part of the course with one class session each week held in the lab. A required course for all students with a major or minor in mathematics and/or engineering. Prerequisite: MA 131-232 or MA 121-122 and simultaneous enrollment in MA 117. Fall semester

**MA 272      Seminar on Mathematical Modeling      1 Cr**

The purpose of this seminar is to give students the opportunity to exercise and develop their mathematical modeling skills. Working in teams, students apply mathematics to solve one or more practical problems. In addition, they research mathematical modeling case studies and present and share the results of their research and modeling work with other teams in the seminar. Offered when demand is sufficient.

**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, transformational geometry, and some history of mathematics. Prerequisite: 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: MA 131-232. Fall semester.

**MA 334      Differential Equations and Linear Algebra      4 Cr**

This is the fourth in a series of four, one-semester, integrated mathematics courses. This course focuses on applications of systems of differential equations including linearization and equilibrium analysis, partial differential equations, and the mathematical underpinnings of linear algebra. Computer visualization is a fundamental part of the course with one class session each week held in the computer lab. This is a required course for all students with a major in mathematics or engineering, or a minor in mathematics. Prerequisite: MA 233. 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, simple linear regression. Students begin to learn how to perform statistical analysis on data sets and draw appropriate conclusions based on their analysis. Graphing calculators and computers are used as appropriate. This is a required course for all students with a major in mathematics or engineering, or a minor in mathematics. Prerequisite: MA 233. 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: MA 334 or consent of instructor. Fall semester.

**MA 342      Numerical Computing and Visualization      3 Cr**

An introductory survey of the basic algorithms used in numerical computing with emphasis on visual presentation of the solution. Consideration is also given to how the algorithm works, when it is appropriate to use, and how to interpret the results. Topics are chosen from modeling and error analysis, roots of equations, curve fitting, numerical differentiation and integration, numerical solutions of ODEs and PDEs, numerical optimization, and numerical linear algebra. Prerequisite: MA 334. Spring semester

**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 geometrics 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: MA 301 and MA 328.

**MA 421      Mathematical Optimization, Applications, and Analysis      3 Cr**

This course focuses on student-led explorations and discussions of application projects from a variety of disciplines. As a senior-level capstone course, it will give students the opportunity to both use and extend much of the mathematics they have learned in their first three years, and it will deepen and broaden their insights regarding the applications of mathematics. Prerequisite: MA 342.

**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 20<sup>th</sup> century developments in mathematics. Required course for mathematics secondary-education majors. Offered when demand is sufficient.