Mathematics

The mathematics major aims to give students insight into the nature of mathematics as an intellectual discipline and to develop the powers of clear and logical thinking, accuracy, flexibility in problem solving, and clarity and precision in expressing mathematical ideas. It further aims to prepare the prospective teacher, provide a sound basis for those students who plan to pursue graduate studies, and provide a background in computing for those students who wish to pursue opportunities in that field.

Mathematics is a requirement for a variety of fields, including actuarial science, operations research, statistics and quality control. In addition, mathematics emphasizes logic and precise communication, providing a good accessory background for students in rational thinking areas such as law and medicine. A Mount Mercy student who wishes to teach secondary mathematics earns the major Mathematics – Education. (See Education section of this *Catalog* for the major requirements).

Mathematic majors build skills that prepare them, for example, to: understand topics in pure and applied mathematics; perform rigorous mathematical proofs; apply mathematics and technology to solve problems in related fields such as science or business; and express mathematical ideas in standard English to a general audience.

Mathematics supports an interdisciplinary degree program in Actuarial Science (http://catalog.mtmercy.edu/curriculum/actuarialscience/) offered through the Business Department. (See Business Administration section of this *Catalog* for the major requirements).

See the Graduate section (http://catalog.mtmercy.edu/graduateprograms/) of this *Catalog* for more information on Graduate programs offered at Mount Mercy.

Mathematics Major

Required:		
CS 105	Fundamentals Of Computer Science	4
DS 101	Introduction to Data Science I	3
MA 162	Discrete Mathematics	3
MA 164	Calculus I	4
MA 165	Calculus II	4
MA 166	Calculus III	3
MA 202	Linear Algebra	3
MA 380	Senior Seminar in Mathematics	3
MA 245	Differential Equations	3
or MA 214	Probability And Statistics	
MA 364	Modern Algebra	3
Choose Mathematics Electives (MA courses above 162. May include one CS course above 105 excluding CS 203.)		**12**
Total Hours		**45**

Students planning to pursue teacher education should follow the program guidelines within the education (http://catalog.mtmercy.edu/curriculum/education/) section of this *Catalog* and contact an advisor in the education department for assistance.

Academic Requirements

Minimum cumulative grade point average of 2.00 in courses required for the major. MA 364 Modern Algebra, MA 374 Analysis I and MA 380 Senior Seminar in Mathematics must be passed with a grade of C or better to be counted toward the major.

No major credit will be given for math courses below MA 162 Discrete Mathematics. Courses that are numbered higher than MA 162 Discrete Mathematics count as math electives. One computer science course numbered higher than CS 105 Fundamentals Of Computer Science, excluding CS 203 Information Ethics, may count as a math elective.

Students cannot double major between Mathematics and Mathematics - Education

Mathematics Minor

Required:		
MA 162	Discrete Mathematics	3
MA 164	Calculus I	4
MA 165	Calculus II	4
MA 166	Calculus III	3
MA 202	Linear Algebra	3
MA 245	Differential Equations	3
or MA 214	Probability And Statistics	
Choose One of the Following:		**3**
CS 105	Fundamentals Of Computer Science	
DS 101	Introduction to Data Science I	
MA 210	Introduction To Graph Theory	
MA 214	Probability And Statistics	
MA 245	Differential Equations	
MA 323	Foundations Of Modern Geometry	
MA 364	Modern Algebra	
MA 399	Special Topics: Mathematics	
Total Hours		**23**

Academic Requirements

Minimum cumulative grade point average of 2.00 in courses required for the minor.

The following is the typical sequence of courses required for the major*:

Freshman

Fall	Hours	Winter	Hours	Spring	Hours
MA 164	4	Domain	3	MA 165	4
CS 105	4			MA 162	3
Writing Competency	4			CO 101	3
Portal	3			Domain	3
	15		**3**		**13**

Sophomore

Fall	Hours	Winter	Hours	Spring	Hours
MA 166	3	Domain	3	MA 202	3
Required Choice 1 or Math Elective[1]	3			Domain or Required Course 1[1]	3
Domain	3			Domain	3
Domain	3			Domain	3
	12		**3**		**12**

Junior

Fall	Hours	Winter	Hours	Spring	Hours
Required Course 2 or Math Elective[1]	3	Math Elective[1]	3	Domain	3
Domain or Math Elective[1]	3			Required Choice 2 or Math Elective[1]	3
Domain	3			Domain	3
Domain	3			Elective	3
Elective	3			Elective	3
	15		**3**		**15**

Senior

Fall	Hours	Winter	Hours	Spring	Hours
Elective or Math Elective[1]	3	Math Elective[1]	3	MA 380	3
Elective	3			Elective or Math Elective[1]	3
Elective	3			Elective	3
Elective	3			Elective	3
Elective	3			Elective	2
	15		**3**		**14**

Total Hours: 123

Note: Elective courses could be used for a second major, a minor, a course of interest, internship or study abroad experience.
Note: See the Curriculum section *(*http://catalog.mtmercy.edu/curriculum/#corecurriculumtext*) for more information on Portal, Competency, Domain, and Capstone courses.*

[1] Required Choice 1: MA 245 Differential Equations or MA 214 Probability And Statistics
Required Choice 2: MA 364 Modern Algebra or MA 374 Analysis I
Math Electives: MA courses about MA 162 Discrete Mathematics. May include one CS course above CS 105 Fundamentals Of Computer Science excluding CS 203 Information Ethics

*Disclaimer

The course offerings, requirements, and policies of Mount Mercy University are under continual examination and revision. This *Catalog* presents the offerings, requirements, and policies in effect at the time of publication and in no way guarantees that the offerings, requirements, and policies will not change.
This plan of study represents a typical sequence of courses required for this major. It may not be applicable to every student. Students should contact a department faculty member to be sure of appropriate course sequence.

Courses

MA 004 Beginning Algebra: 1 semester hour
This course is designed to provide remedial work for those students who enter college poorly prepared in mathematics. Class will focus on basic computational skills, dimensional analysis, irrational numbers, scientific notation, interpretation of graphs, basic geometric concepts, and an introduction to basic algebra. Emphasis will be on problem solving and reading for math.

MA 006 Intermediate Algebra II: 2 semester hours
The class covers the topics of intermediate algebra including inequalities, linear equations, systems of linear equations, quadratic equations, exponents, ratio, proportion, variation, and graphing. Returning students who have not been in a math class for a number of years might find this course a good choice in preparation for their statistics or core curriculum mathematics course. It offers a review of mathematics concepts. For students placed in the class, it is a prerequisite for their core curriculum class choice.

MA 125 Fundamentals Of Arithmetic & Logic: 3 semester hours
This course will introduce some key concepts of mathematics: sets, logic, and numbers. We will use these to understand the Hindu Arabic numeration system, arithmetic, and measurement. In particular, we look at how numbers and operations correspond to reality and why our computational algorithms work. This course is designed to cover ideas of interest to the elementary education major; it does not prepare a student for the computational portion of the GRE. Elementary Education majors are given preference in enrolling in this course. Prerequisite: Two years of high school algebra or MA 006.

MA 130 Finite Mathematics: 3 semester hours
Finite mathematics will look briefly at a variety of topics, including systems of linear equations, matrices, linear programming, combinatorics, probability, sequences and series, and interest on money. Prerequisite: Two years of high school algebra or MA 006.

MA 132 Basic Mathematical Modeling: 3 semester hours
A mathematical model is a simplification of reality that is mathematically manageable. This course examines some specific models that are widely useful, but most of its focus is on choosing or creating a model, using the model to draw conclusions and refining a model when it is not sufficiently useful. Hence, mathematics is used to solve real life problems. Technology (e.g. Excel) will be used frequently. While algebra skills are needed, additional mathematics will be developed within the course; in particular, difference equations are necessary and logarithms are useful. Prerequisite: high school algebra 2 or MA 006 Intermediate Algebra, or departmental approval.

MA 135 Basic Statistics: 3 semester hours
This course is an introduction to the basics of probability as well as descriptive and inferential statistics. Topics include measures of central tendency, measure of dispersion, histograms, the normal and binomial distributions, hypothesis testing, confidence intervals, chi-square distribution, correlation, and prediction. Prerequisite: two years of high school algebra, MA 006, or departmental approval.

MA 139 Pre-Calculus: 4 semester hours
Pre-Calculus is a collection of topics necessary for the successful completion of a year of calculus. Basically, a good knowledge of pre-calculus is a comfortable familiarity with the idea of function and with most of the basic functions, including polynomials, rational functions, exponential, logarithmic and trigonometric functions. This comfortable familiarity allows one to solve equations and inequalities involving these various functions and to produce function rules from graphs or graphs from function rules. Prerequisite: three years of high school mathematics (including Algebra 2 and Geometry), an A- in MA 006, or the consent of the instructor.

MA 145 History of Mathematics for Elementary Education: 3 semester hours
This is a combination of the mathematics that elementary education majors have already seen with the history of mathematics. The goal is for elementary teachers to have a sense of what mathematics is and how the skills they will teach connect to modern mathematics. The course will include a study of the evolution of mathematics from ad hoc empirical techniques to the Greek notion of mathematics as a theoretical structure which gives certain knowledge about reality, which in turn yielded to modern mathematics - an abstract construct, possibly consistent, which does not of necessity illuminate reality. Prerequisite: At least 18 hours of the mathematics required for the original endorsement in elementary mathematics.

MA 162 Discrete Mathematics: 3 semester hours
The purpose of this course is to present various mathematical topics including an introduction to proof writing as well as topics that are essential to computer science. Topics to be covered include non-decimal numeration systems; prefix and postfix notation; the basic operations of sets, relations, and functions; induction and recursion; equivalence and congruence relations; propositional logic, truth tables, logical equivalence, and implications; non-decimal numeration systems; prefix and postfix notation; Boolean algebra and switching theory; matrices and determinants; permutations and combinations; graph theory and directed graphs. Prerequisite: MA 139 or equivalent, or permission of instructor.

MA 164 Calculus I: 4 semester hours
Introduction to Calculus I begins with a review of analytical geometry and basic functions. It then introduces limits, continuity, the derivative, and the antiderivative. Also included are the techniques of differentiation and applications of the derivative. Prerequisite: grade of C or better in MA 139 or equivalent course or permission of instructor.

MA 165 Calculus II: 4 semester hours
This course introduces the definite integral and its applications along with the techniques of integration. It also includes logarithmic and exponential functions, the trigonometric functions, and their universes. Prerequisite: grade of C or better in MA 164.

MA 166 Calculus III: 3 semester hours
Calculus III includes the more advanced topics of basic calculus. Included are polar coordinates, approximate integrations, indeterminate forms and improper integrals, solid analytic geometry, infinite series and functions of several variables. Prerequisite: grade of C or better in MA 165.

MA 202 Linear Algebra: 3 semester hours
This course introduces the basic topics and techniques of linear algebra. Topics include linear systems, matrices, determinants, general vector spaces, subspaces, basic and dimension, inner product spaces, orthonormal bases, changing bases, linear transformations and their properties, eigenvalues, eigenvectors, diagonalization. Students will gain mathematical maturity in writing proofs. Students are encouraged to take MA162 before this course. Prerequisite: MA 164.

MA 210 Introduction To Graph Theory: 3 semester hours
This course introduces concepts of graph theory and some of the most interesting and important theoretical results in the field. Concepts discussed include directed and undirected graphs, trees and general graphs, planarity in graphs, graph colorings, network flow and connectivity, matching and independent sets, and graph algorithms and applications. Prerequisite: MA 162.

MA 214 Probability And Statistics: 3 semester hours
The basic concepts of probability theory and mathematical statistics will be examined. Topics to be discussed include probability spaces, random variables, multivariate distributions, expectation, random sampling, central limit theorem, and confidence intervals. Prerequisite: MA 162 and MA 165.

MA 245 Differential Equations: 3 semester hours
Methods of solution for the first-order as well as higher order differential equations will be discussed. Other topics to be covered include problems in mechanics, rate problems, series solutions, and systems of linear differential equations. Corequisite: MA 166.

MA 250 Mathematical Theory of Interest: 3 semester hours
This course is an introduction to financial mathematics and is designed for those who want to study for the Society of Actuaries' exam on financial mathematics. Topics will include the measurement of interest, annuities using sequences and series, amortization schedules and other relevant topics. Prerequisite: MA 165.

MA 266 Introduction To Numerical Methods: 3 semester hours
The purpose of this course is to introduce the numerical techniques used in the solution of mathematical problems. Topics include interpolation, non-linear equations, systems of linear equations, error analysis and norms, matrix inversion, differentiation, integration, and curve fitting. Prerequisite: MA 165.

MA 323 Foundations Of Modern Geometry: 3 semester hours
This course aims at showing the student the need for a rigorous, abstract, deductive treatment of geometry. It includes a study of geometry developed without using a parallel postulate and goes on to show how separate geometrics evolve when different parallel postulates are added, in turn, to common body definitions, axioms, and theorems. Prerequisites: Grade of C or better in MA 162.

MA 364 Modern Algebra: 3 semester hours
Modern algebra introduces the student tot groups, rings, integral domains, and fields using as examples the ring of integers and the fields of rational, real, and complex numbers. Also included are isomorphisms and homomorphism. Prerequisite: grade of C or better in MA 202 and MA 162.

MA 374 Analysis I: 3 semester hours
Analysis develops the theoretical underpinnings of calculus. The key idea is a precise definition of limit, one which never used the words "infinitely close" or "infinitely small". Using this fundamental definition, we revisit the ideas of calculus: continuity, the derivative and the integral. In addition, we consider sequences and the topology of the real numbers. Prerequisite: grade of C or better in MA 202 and MA 162.

MA 380 Senior Seminar in Mathematics: 3 semester hours
This course is a capstone experience for students in technical majors such as Mathematics, Data Science and Actuarial Science. Students will devise a project with guidance from the instructor. Class activities may include reading scholarly and professional resources, giving regular presentations, working problems, understanding theorems, performing calculations, writing code, managing data, etc. Students may choose to use this course to organize studying for a professional exam. Students can expect to present regularly on their activities and write extensively on their results.

MA 399 Special Topics: Mathematics: 3 semester hours
This course gives students the opportunity to take electives in areas of special interest to them since the topic covered varies from one semester to the next. Topics selected from both pure and applied mathematics such as real analysis, complex analysis, number theory, set theory, optimization theory, graph theory, coding theory, fractals, and operations research will be taught. This course may be taken more than once provided a different topic is being taken each time. Prerequisite MA 162, MA 166, and MA 202 or permission of the instructor. (Offered every year).

MA 425 Internship in Mathematics: 3 semester hours
Special opportunities may be available with area businesses for an internship involving topics in mathematics. These internships include off-campus supervision at the business and periodic meetings with the on-campus instructor who will also determine any additional requirements on an individual basis. (Maximum of one semester credit for each forty hours worked at the business, up to a maximum of 6 semester hours, a maximum of 3 of which can count for a mathematics major elective.).

MA 445 Independent Study: 3 semester hours
Study topics will be negotiated by the student and his/ her advisor.