Department of Mathematics

Chair: Rudi Weikard
Associate Chair: John C. Mayer

The Department of Mathematics offers courses in pure and applied mathematics and a major and minor in mathematics leading to employment in education, government, business, and industry. In addition, mathematics courses are offered to support programs in the physical, social, biological, and health sciences and in engineering, business, and education. Students considering a major or minor in mathematics should consult the undergraduate advisor, Dr. Hutchison, at (205) 934-2154 to arrange for counseling on career and academic objectives and program planning.

The Department of Mathematics Web site (http://www.uab.edu/mathematics/) summarizes information about the Departmental programs.

For the major there are four distinct B.S. degree tracks in mathematics:

1. Mathematics (traditional track)
2. Mathematics with Honors
3. Applied Mathematics and Scientific Computation
4. Mathematical Reasoning

Students interested in secondary teaching certification in mathematics normally take the traditional track. Students interested in middle school teaching normally take the mathematical reasoning track. Certification courses are part of the UABTeach (https://www.uab.edu/uabteach) program.

Mathematics Fast-Track Program

The Department of Mathematics has an accelerated program for qualified students. Through this Fast-Track option, a mathematics major can earn a BS degree and an MS degree in mathematics in four to five years (depending upon whether summer terms are included). As another option, students can pursue a BS in mathematics and an MS in biostatistics by choosing the biostatistics track at the end of the third year. Each individual Fast-Track student works with a mentor from the graduate faculty on a mathematics research project during every term. Fast-Track students will usually begin taking graduate mathematics courses after the third year, and are automatically admitted to the graduate program in the fourth year, if performing satisfactorily. Students who complete this program will be prepared for continued graduate work in mathematics and the sciences, or for careers in industry. Fast-Track scholarships are available. For more information, contact the Honors Program Director, Dr. Oversteegen, at (205) 934-2154.

Course Numbering System

Mathematics course numbers indicate both the level and area of the course. The first digit (0, 1, 2, 3, or 4) indicates developmental (no degree credit), freshman, sophomore, junior, or senior level, respectively. The second and third digits indicate area, according to this scheme:

- 00–10 — Pre-calculus
- 11–19 — History of mathematics and mathematical reasoning
- 20–29 — Logic and foundations
- 30–39 — Algebra
- 40–49 — Analysis
- 50–59 — Differential equations
- 60–69 — Applications-oriented courses
- 70–79 — Geometry and topology
- 80–89 — Probability and statistics
- 90–99 — Special topics, seminars, and independent research

For example, MA 454 Intermediate Differential Equations is an advanced level differential equations course. Calculus courses (MA 125, MA 126, and MA 227) are exceptions to the area numbering scheme.

Graduate Programs

The Department of Mathematics offers graduate study leading to the degrees of Master of Science in mathematics (thesis or non-thesis option) and Doctor of Philosophy in applied mathematics. Further information may be obtained from the Graduate Program Director, or the UAB Graduate School Catalog.

See the UAB Graduate School Catalog for descriptions of graduate courses.

Bachelor of Science with a Major in Mathematics

Requirements		Hours
Required Mathematics Courses [1]		
Thirty-nine semester hours with twenty-four at the 300 level or above		
MA 125	Calculus I	4
or MA 225	Calculus I - Honors	
MA 126	Calculus II	4
or MA 226	Calculus II - Honors	
MA 227	Calculus III	4
MA 252	Introduction to Differential Equations	3
MA 434	Algebra I: Linear	3
MA 440	Advanced Calculus I	3
MA 441	Advanced Calculus II	3
Select one of the following:		3
MA 360	Scientific Programming	
CS 380	Scientific Computing	
MA 361	Mathematical Modeling	
MA 461	Modeling with Partial Differential Equations	
MA 468	Numerical Analysis	
Mathematics Electives and Advanced Mathematics Sequence		12
Two or three electives selected from courses numbered 300 or above, each of which must have at least a calculus (MA 125) prerequisite. MA 313 counts toward the major only for students in UABTeach. MA 411 does not count toward the major.		
Choose one of the following Advanced Mathematics sequences:		
MA 434 & MA 435	Algebra I: Linear and Algebra II: Modern [2]	
MA 454 & MA 455	Intermediate Differential Equations and Partial Differential Equations I	
MA 455 & MA 461	Partial Differential Equations I and Modeling with Partial Differential Equations	
MA 463 & MA 464	Operations Research I and Operations Research II	

MA 470 & MA 471	Differential Geometry I and Differential Geometry II	
MA 474 & MA 475	Introduction to Topology I and Introduction to Topology II	
MA 485 & MA 486	Probability and Mathematical Statistics	
MA 485 & MA 587	Probability and Advanced Probability	
Total Hours		**39**

1. Completion of MA 125 automatically satisfies the Core Curriculum Area III: Math requirement. MA 126, MA 252 and MA 361 are all quantitative literacy (QL) and writing (W) courses satisfying the QEP requirements of the core. In addition, MA 125 is a QL course. UAB requires that all students complete a capstone requirement. For this track the capstone requirement is MA 441 .
2. Three electives are required if MA 434/MA 435 is chosen as the advanced sequence.

Grade Requirement

A grade of C or better is required in each course counted toward the major.

Minor

- A minor is required for this degree. Those interested in secondary education can select the STEM Education minor offered by the School of Education.

General Electives

Students must take general electives to reach the 120 semester hour requirement

Bachelor of Science with a Major in Mathematics and an Applied Mathematics and Scientific Computation Track

This track aims to provide graduates with the mathematical and computational skills needed to develop and maintain mathematical models from the Sciences, Engineering, Medicine and the Biosciences, Business, and elsewhere.

A mathematical model is a rendering of some real-world system into the language of mathematics, usually taking the form of a single partial differential equation, or a system of such equations. The development of effective mathematical models is a fundamental need of our society, based as it is upon science and technology, and these models act as the indispensable link between us humans and the multitude of machines that we use to manage and investigate our world.

Requirements		**Hours**
Required Mathematics Courses [1]		
39 semester hours with 21 hours at the 300 level or above		
MA 125	Calculus I	4
or MA 225	Calculus I - Honors	
MA 126	Calculus II	4
or MA 226	Calculus II - Honors	
MA 227	Calculus III	4
MA 252	Introduction to Differential Equations	3
MA 260	Introduction to Linear Algebra [2]	3
or MA 434	Algebra I: Linear	
MA 360	Scientific Programming	3
or CS 380	Scientific Computing	
MA 455	Partial Differential Equations I	3
or MA 461	Modeling with Partial Differential Equations	
or MA 486	Mathematical Statistics	
Mathematics Electives		6
Two additional electives selected from courses numbered 300 or above, and from areas 30-99 of the course numbering system for mathematics		
Advanced Mathematics Electives		9
Select three additional electives from the following courses:		
MA 435	Algebra II: Modern	
MA 444	Vector Analysis	
MA 445	Complex Analysis	
MA 454	Intermediate Differential Equations	
MA 455	Partial Differential Equations I	
MA 461	Modeling with Partial Differential Equations	
MA 462	Intro to Stochastic Differential Equations	
MA 463	Operations Research I	
MA 464	Operations Research II	
MA 465	Partial Differential Equations: Finite Diff. Meth.	
MA 467	Gas Dynamics	
MA 468	Numerical Analysis	
MA 484	Mathematical Finance	
MA 485	Probability	
MA 486	Mathematical Statistics	
MA 497	Research Methods in Mathematics	
MA 587	Advanced Probability	
Total Hours		**39**

1. Completion of MA 125 automatically satisfies the Core Curriculum Area III: Math requirement. MA 126 and MA 252 are quantitative literacy (QL) and writing (W) courses satisfying the QEP requirements of the Core Curriculum. In addition, MA 125 is a QL course. UAB requires that all students must complete a capstone requirement. For this track the capstone requirement is one of MA 455, MA 461,and MA 486.
2. MA 260 Introduction to Linear Algebra and MA 434 Algebra I: Linear cannot both be counted.

Grade Requirement

A grade of C or better is required in each course counted toward the major.

Minor

- A minor in the sciences, business, or engineering is required for this degree. Students in UABTeach (https://www.uab.edu/uabteach) may select the minor in STEM Education offered by the School of Education.

General Electives

Students must take general electives to reach the 120 semester hour requirement.

Bachelor of Science with a Major in Mathematics and a Mathematical Reasoning Track

The Mathematical Reasoning Track is designed to develop a deeper level of understanding of mathematical thinking, including a deepening knowledge of important mathematical ideas, understanding the role of inquiry and reflection in learning mathematics, understanding the role of cultivating a productive disposition in tackling mathematical problems, and developing the ability to communicate mathematics to audiences at different levels. In particular, this track is appropriate for students interested in pursuing certification in mathematics at the middle school level.

Requirements		Hours
Required Mathematics Courses [1]		
MA 125	Calculus I	4
or MA 225	Calculus I - Honors	
Select two courses from the following three groups:		6-7
MA 106	Pre-Calculus Trigonometry [2]	
or MA 107	Pre-Calculus Algebra and Trigonometry	
MA 110	Finite Mathematics	
or MA 418	Statistics for Teachers	
MA 126	Calculus II	
or MA 226	Calculus II - Honors	
Additonal Required Mathematics Courses		
MA 311	History of Mathematics I	3
MA 313	Patterns, Functions and Algebraic Reasoning	3
MA 314	Geometric and Proportional Reasoning	3
MA 316	Numerical Reasoning	3
MA 361	Mathematical Modeling	3
MA 411	Integrating Mathematical Ideas	3
Mathematics Electives		
Two electives selected from courses numbered 227 and above.		6
Total Hours		**34-35**

1. Completion of MA 106 or MA 107 automatically satisfies the Core Curriculum Area III: Math requirement. MA 106, MA 107, MA 110, MA 125, MA 361, MA 418 are all quantitative literacy courses satisfying the QEP requirements of the Core Curriculum. In addition, MA 361 is a QEP writing (W) course. UAB requires that all students complete a capstone requirement. The capstone requirement for this track is MA 411 . At least three courses in this major must be at the 400 level.
2. Students cannot count both MA 106 and MA 107 toward their major.
3. MA 419 cannot be repeated for credit toward this major.

Grade Requirements

A grade of C or better is required in each course counted toward the major. Requirements are 34-36 semester hours in mathematics with 24 at the upper level (courses numbered 300 and above). Nine hours must be taken at the 400 level.

Minor

- A minor is required for this degree. Those interested in middle school education can select the STEM Education minor offered by the School of Education.

General Electives

Students must take general electives to reach the 120 semester hour requirement

Proposed Program of Study for a Major in Mathematics with a Traditional Track

Freshman

First Term	Hours	Second Term	Hours
MA 125	4	MA 126	4
EH 101	3	EH 102	3
HY 101	3	HY 102	3
ARH 101	3	CS 103	4
	13		**14**

Sophomore

First Term	Hours	Second Term	Hours
MA 227	4	MA 252	3
EH 216	3	MA 361	3
PH 221	4	CS 250	3
CS 203	4	PH 222	4
		General Elective	3
	15		**16**

Junior

First Term	Hours	Second Term	Hours
MA 434	3	MA 435	3
MA 485	3	MA 486	3
CMST 101	3	EC 210	3
CS 303	4	CS 330	3
PY 101	3	PHL 115	3
	16		**15**

Senior

First Term	Hours	Second Term	Hours
MA 440	3	MA 441	3
MA 472	3	General Electives	13
MA 311	3		
General Elective	6		
	15		**16**

Total credit hours: 120

Proposed Program of Study for a Major in Mathematics with a Traditional Track and Leading to Secondary Teaching Certification

Freshman

First Term	Hours	Second Term	Hours
MA 125	4	MA 126	4
EH 101	3	EH 102	3
HY 101	3	HY 102	3
ARH 101	3	PY 101	3
EHS 125	1	EHS 126	1
	14		**14**

Sophomore

First Term	Hours	Second Term	Hours
MA 227	4	MA 252	3
MA 361	3	PH 222	4

PH 221	4 EH 216	3
EHS 325	3 HY 275	3
	Elective	3
	14	**16**

Junior

First Term	Hours	Second Term	Hours
MA 434	3	MA 435	3
MA 472	3	MA 486	3
MA 485	3	EC 210	3
CMST 101	3	PHL 115	3
EHS 326	3	Elective	4
	15		**16**

Senior

First Term	Hours	Second Term	Hours
MA 440	3	MA 441	3
EHS 327	3	EHS 425	6
MA 497	1-3	EHS 426	1
Elective	7	Elective	5
	14-16		**15**

Total credit hours: 118-120

Proposed Program of Study for a Major in Mathematics with an Applied Mathematics and Scientific Computation Track

Freshman

First Term	Hours	Second Term	Hours
MA 125	4	MA 126	4
EH 101	3	EH 102	3
HY 101	3	HY 102	3
Core Area II or IV course	3	Core Area II or IV Course	3
CAS 112 or EHS 125	1	General Elective	3
	14		**16**

Sophomore

First Term	Hours	Second Term	Hours
MA 227	4	MA 252	3
Core EH Literature	3	Core Area II or IV Course	3
Course in Minor	3	Core Area III Ccience	4
Core Area III Science	4	Course in Minor	3
		General Elective	3
	14		**16**

Junior

First Term	Hours	Second Term	Hours
MA 360	3	MA 260	3
MA 4XX Elective	3	MA 4XX elective	3
Core Area II or IV Courses	6	Course in Minor	3
Course in Minor	3	Core Area II or IV Course	3
		General Elective	3
	15		**15**

Senior

First Term	Hours	Second Term	Hours
MA 4XX Elective	3	MA 4XX Elective	3
Course in Minor	3	MA Elective	3
MA Elective	3	Course in Minor	3
General Electives	6	General Electives	6
	15		**15**

Total credit hours: 120

Proposed Program of Study for a Major in Mathematics with a Mathematical Reasoning Track

Freshman

First Term	Hours	Second Term	Hours
MA 110 or 418	3	MA 106	3
EH 101	3	EH 102	3
HY 101	3	HY 102	3
Core Area II or IV Course	3	Core Area II or IV Course	3
EHS 125	1	EHS 126	1
General Elective	3	General Elective	3
	16		**16**

Sophomore

First Term	Hours	Second Term	Hours
MA 125	4	MA 314	3
MA 313	3	Core Area II or IV Course	3
Core EH Literative	3	General Elective	3
Core Area II or IV Course	3	Core Area III Science	4
EHS 325	3	HY 275	3
	16		**16**

Junior

First Term	Hours	Second Term	Hours
MA 311	3	MA 361	3
EHS 326	3	MA 411	3
Core Area III Science	4	MA 4XX Approved Elective	3
Core Area II or IV Course	3	Core Area II or IV Course	3
General Elective	3	General Elective	3
	16		**15**

Senior

First Term	Hours	Second Term	Hours
MA 311	3	EHS 425	6
MA 4XX Approved Elective	3	EHS 426	1
EHS 327	3	General Elective	3
General Electives	6		
	15		**10**

Total credit hours: 120

The above schedule assumes the student is in UABTeach (https://www.uab.edu/uabteach) and is pursuing middle school certification. If not, EHS courses should be replaced by courses fulfilling requirements for a minor course of study.

Minor in Mathematics

Requirements		Hours
Required Mathematics Courses		
MA 125	Calculus I [1]	4
MA 126	Calculus II	4
MA 227	Calculus III	4
Mathematics Electives		

Select nine hours from Mathematics courses numbered 200 or above. [2]	9
Total Hours	**21**

1. MA 125 Calculus I may also satisfy the Core Curriculum Area III: Math requirement; check the Core Curriculum for your particular major.
2. At least 6 semester hours of which must have a calculus (MA 125) prerequisite. (MA 260 Introduction to Linear Algebra and MA 434 Algebra I: Linear cannot both be counted.) MA 411 does not count toward the minor.

GPA & Residency Requirement

A minimum grade of C is required in all courses applied to the minor. A minimum of six semester hours with a calculus (MA 125) prerequisite must be completed at UAB.

Honors Program

The Mathematics Honors Program is designed for advanced, motivated students. Through a mentored research program format and seminars, research and communication skills are developed in preparation for a graduate or professional career.

The Mathematics Honors Program fosters a spirit of inquiry, independence, and initiative along with providing an overview of the relationships among the branches of mathematics studied. The student will have an early opportunity to tackle a mathematical research project while interacting one-on-one with faculty members in a research setting. The mentoring, the approved seminars, and the oral presentation or poster should all contribute to the student's development. Upon completion of the program, the student will graduate "With Honors in Mathematics."

Acceptance into the Mathematics Honors Program requires the student:

- to be a mathematics major in the traditional track;
- to have earned a 3.5 GPA in mathematics courses attempted;
- to have earned a 3.0 GPA overall;
- to have arranged with one or more faculty mentors to work on undergraduate research projects for six semester hours distributed over two or more terms; and
- to have filled out and submitted the Mathematics Honors Program application form to the Undergraduate Program Director.

Major requirements for the Mathematics Honors Program:

- to be a mathematics major in the traditional track;
- to complete an additional 9 hours of approved seminar (3 hours) and research (6 hours);
- to have earned a 3.5 GPA in mathematics courses and a 3.0 GPA overall; and
- to present an oral or poster presentation on mathematics in an academic setting

Suggested Curriculum for the Honors Program:

Freshman

First Term	Hours	Second Term	Hours
MA 125	4	MA 126	4
EH 101	3	EH 102	3
HY 101	3	HY 102	3
ARH 101	3	EC 210	3
FYE/FLC Course (credit hours may vary)	2	PHL 115	3
	15		**16**

Sophomore

First Term	Hours	Second Term	Hours
MA 227	4	MA 252	3
MA 298	1	MA 361	3
MA 434	3	MA 298	1
EH 216	3	PH 221	4
EC 210	3	EC 211	3
Minor Course	3		
	17		**14**

Junior

First Term	Hours	Second Term	Hours
MA 398	1	MA 441	3
MA 440	3	MA Elective	3
MA 490	1	MA 398	1
PH 222	4	MA 490	1
MA Elective	3	CMST 101	3
Minor Course	3	Minor Course	3
	15		**14**

Senior

First Term	Hours	Second Term	Hours
MA 490	1	MA Sequence	3
MA sequence	3	MA 490	1
MA 498	1	MA 498	1
Minor Courses	6	Minor Courses	3
General Electives	4	General Electives	6
	15		**14**

Total credit hours: 120

Courses

MA 094. Basic Mathematics. 3 Hours.
Whole numbers, fractions, decimals, ratios and proportions, percentages, integers, basic geometry, and basic algebra including linear equations and applications. Designed to prepare students for MA 110, Finite Mathematics. Students preparing to take MA 102 should take MA 098. Attendance at the first meeting is mandatory. MA 094 section QL is an on-line version of MA 094 intended primarily for students who have job conflicts or live a long distance from the campus. There are no campus based meetings with the on-line class. However, students in the on-line version of MA 094 are required to interact with peers and the instructor through an on-line format and should be able to work independently and be motivated self-starters who are confident in their ability to master mathematics. Non-credit; does not contribute to any degree requirements. 0.000 Credit Hours.

MA 098. Basic Algebra. 3 Hours.
Arithmetic of integers, rational numbers, real numbers, exponents, polynomial algebra, factoring, rational functions, linear and quadratic equations, elementary geometry, verbal problems. Designed to prepare students for college level math courses. Attendance at the first day of class is mandatory. Attendance at the first lab meeting is mandatory. MA 098 section QL is an on-line version of MA 098 and is intended primarily for students who have job conflicts or live a long distance from the campus. There are no campus based meetings with the on-line class. However, students in the on-line version of Ma098 are required to interact with peers and the instructor through an on-line format and should be able to work independently and be motivated self-starters who are confident in their ability to master mathematics. Non-credit; does not contribute to any degree requirements. 0.000 Credit Hours.

MA 102. Intermediate Algebra. 3 Hours.
Absolute values, Cartesian coordinates, graphs of linear equations, concept of a function, linear systems, algebra of polynomials, factoring of polynomials, algebra of rational expressions, literal equations, word problems involving linear, rational and quadratic models, integer and rational exponents, radical expressions, rational, radical and quadratic equations, complex numbers. Consists of one, mandatory, scheduled 50 minute lecture per week, plus one, mandatory, scheduled 50 minute lab meeting per week, plus 50 minutes of individually scheduled lab time per week. Quantitative Literacy is a significant component of this course. MA 102 section QL is an on-line version of MA 102 and is intended primarily for students who have job conflicts or live a long distance from the campus. There are no campus based meetings with the on-line class. However, students in the on-line version of MA 102 are required to interact with peers and the instructor through an on-line format and should be able to work independently and be motivated self-starters who are confident in their ability to master mathematics.
Prerequisites: MA 098 [Min Grade: P] or (A02 20 and HSCG 2.50) or A02 21 or (S02 480 and HSCG 2.50) or S02 500 or MAAD 15 or MA1 085 or MA 098 [Min Grade: C] or (SAT2 510 and HSCG 2.50) or SAT2 530

MA 105. Pre-Calculus Algebra. 3 Hours.
Functions from algebraic, geometric (graphical), and numerical points of view, including polynomial, rational, logarithmic, and exponential functions; inverse functions; systems of equations and inequalities; quadratic and rational inequalities; complex and real roots of polynomials; applications and modeling, both scientific and business. Supports development of quantitative literacy. Consists of one scheduled 50 minute lecture per week, plus one 50 minute scheduled lab meeting per week, plus 50 minutes of individually scheduled lab time per week. Attendance at the first day of class is mandatory. Attendance at the first lab meeting is mandatory. May not be enrolled in Undergraduate Certificate. Lecture, online at least 80%. Quantitative Literacy is a significant component of this course. This course meets the Core Curriculum requirements for Area III: Mathematics.
Prerequisites: MA 102 [Min Grade: C] or (A02 22 and HSCG 3.50) or (A02 23 and HSCG 3.00) or (A02 24 and HSCG 2.50) or (S02 520 and HSCG 3.50) or (S02 540 and HSCG 3.00) or (S02 560 and HSCG 2.50) or S02 580 or MAAD 21 or MA2 080 or A02 25 or (SAT2 550 and HSCG 3.50) or (SAT2 570 and HSCG 3.00) or (SAT2 580 and HSCG 2.50) or SAT2 600

MA 106. Pre-Calculus Trigonometry. 3 Hours.
Trigonometric functions (circular functions) and their inverses, graphs, and properties; right triangle trigonometry and applications; analytical trigonometry, trigonometric identities and equations; polar coordinates; complex numbers; laws of sines and cosines; conic sections. Supports development of quantitative literacy. Consists of one scheduled 50 minute lecture per week, plus one 50 minute scheduled lab meeting per week, plus 50 minutes of individually scheduled lab time per week. Attendance at the first day of class is mandatory. Attendance at the first lab meeting is mandatory. Quantitative Literacy is a significant component of this course. This course meets the Core Curriculum requirements for Area III: Mathematics.
Prerequisites: MA 105 [Min Grade: C] or (A02 25 and HSCG 3.50) or (A02 26 and HSCG 3.00) or A02 27 or (S02 580 and HSCG 3.50) or (S02 600 and HSCG 3.00) or S02 620 or MAC1 17 or MA3 080 or (SAT2 600 and HSCG 3.50) or (SAT2 620 and HSCG 3.00) or SAT2 640

MA 107. Pre-Calculus Algebra and Trigonometry. 4 Hours.
Functions, their graphs and applications, including polynomial, rational, algebraic, exponential, logarithmic, and trigonometric functions. A fast-paced course designed as a review of the algebra and trigonometry needed in calculus. (MA107 is a combination of MA105 Pre-Calculus Algebra and MA106 Pre-Calculus Trigonometry taught in a single semester.) Satisfies core curriculum requirement in mathematics. Supports development of quantitative literacy. Consists of two scheduled 50 minute lectures per week, plus one 50 minute scheduled lab meeting per week, plus 50 minutes of individually scheduled lab time per week. Attendance at the first day of class is mandatory. Attendance at the first lab meeting is mandatory. Quantitative literacy is a significant component of this course. This course meets the Core Curriculum requirements for Area III: Mathematics.
Prerequisites: MA 102 [Min Grade: B] or (A02 24 and HSCG 3.50) or (A02 25 and HSCG 3.00) or (A02 26 and HSCG 2.50) or A02 27 or MAAD 21 or MA4 085 or (S02 560 and HSCG 3.50) or (S02 580 and HSCG 3.00) or (S02 600 and HSCG 2.50) or S02 620 or (SAT2 580 and HSCG 3.50) or (SAT2 600 and HSCG 3.00) or (SAT2 620 and HSCG 2.50) or SAT2 640

MA 110. Finite Mathematics. 3 Hours.
An overview of topics of finite mathematics and applications of mathematics for the liberal arts student. Topics include counting, permutations, combinations, basic probability, conditional probability, descriptive statistics, binomial and normal distributions, statistical inference, and additional selected topics. Students construct models of problem situations, translate verbal descriptions into mathematical form, interpret and create schematic representations of mathematical relationships, use quantitative evidence as a basis for reasoning, argument, and drawing conclusions, and communicate their results to an audience appropriately. May not be enrolled in Undergraduate Certificate. Quantitative Literacy is a significant component of this course. This course meets the Core Curriculum requirements for Area III: Mathematics.
Prerequisites: MA 094 [Min Grade: C] or MA 098 [Min Grade: C] or MA 102 [Min Grade: C] or (A02 20 and HSCG 2.00) or A02 21 or (S02 480 and HSCG 2.00) or S02 500 or MAAD 15 or MA1 085 or (SAT2 510 and HSCG 2.00) or SAT2 530

MA 120. Introduction to Symbolic Logic. 3 Hours.
Modern theory of deductive inference. Emphasis on recognizing valid forms of reasoning. Truth-function theory and some concepts of one-variable quantification theory. May not be used to satisfy Core Curriculum requirement in mathematics.

MA 125. Calculus I. 4 Hours.
Limit of a function; continuity, derivatives of algebraic, trigonometric exponential, and logarithmic functions, application of derivative to extremal problems, optimization, and graphing; Newton method; the definite integral and its application to area problems; fundamental theorem of integral calculus, average value, and substitution rule. Quantitative literacy is a significant component of this course. This course meets the Core Curriculum requirements for Area III: Mathematics.
Prerequisites: MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or (A02 25 and HSCG 3.50) or (A02 26 and HSCG 3.00) or A02 27 or (S02 580 and HSCG 3.50) or (S02 600 and HSCG 3.00) or S02 620 or MAC2 16 or MA5 080 or (SAT2 600 and HSCG 3.50) or (SAT2 620 and HSCG 3.00) or SAT2 640

MA 126. Calculus II. 4 Hours.
Techniques of integration; applications in integration such as volume, arc length and work; infinite series, Taylor series; polar coordinates; parametric equations; plane and space vectors; lines and planes in space. Quantitative Literacy is a significant components of this course. This course meets the Core Curriculum requirements for Area III: Mathematics.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 180. Introduction to Statistics. 3 Hours.
Descriptive and inferential statistics, probability distributions, estimation, hypothesis testing. Quantitative Literacy is a significant component of this course.
Prerequisites: MA 102 [Min Grade: C] or MA 105 [Min Grade: C] or MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 110 [Min Grade: C] or MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 224. Intermediate Symbolic Logic. 3 Hours.
Full development of quantification theory, including identity and definite description, and soundness and completeness proofs. Skill in formal proof emphasized, as well as ability to express arguments from natural language in artificial language.
Prerequisites: MA 120 [Min Grade: C] or PHL 220 [Min Grade: C]

MA 225. Calculus I - Honors. 4 Hours.
Limit of a function; continuity, derivatives of algebraic, trigonometric exponential, and logarithmic functions, application of derivative to extremal problems, optimization, and graphing; Newton method; the definite integral and its application to area problems; fundamental theorem of integral calculus, average value, and substitution rule. Students will be required to display an in-depth understanding of these topics through a complete justification of their work on tests and through participation in class projects. Quantitative literacy is a significant component of this course.
Prerequisites: MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or (A02 25 and HSCG 3.50) or (A02 25 and HSCG 3.50) or A02 27 or (S02 580 and HSCG 3.50) or (S02 600 and HSCG 3.00) or MAC2 16 or MA5 080

MA 226. Calculus II - Honors. 4 Hours.
Techniques of integration; applications in integration such as volume, arc length and work; infinite series, Taylor series; polar coordinates; parametric equations; plane and space vectors; lines and planes in space. Quantitative Literacy is a significant component of this course.
Prerequisites: MA 225 [Min Grade: C] or MA 125 [Min Grade: C]

MA 227. Calculus III. 4 Hours.
Vector functions, functions of two or more variables, partial derivatives, quadric surfaces, multiple integration and vector calculus, including Greens Theorem, curl and divergence, surface integrals, and Gauss' and Stokes' Theorem. This course meets the Core Curriculum requirements for Area III: Mathematics.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 252. Introduction to Differential Equations. 3 Hours.
First order differential equations (separable, linear, exact, and additional non-linear examples using MAPLE), modeling with first order DE's, examples of systems of first order DE's, theory of higher order linear DE's (homogeneous and non-homogeneous, superposition of solutions, linear independence and general solutions, initial and boundary value problems), solution of constant coefficient homogeneous linear equations, variation of parameters and Green's functions with complicated cases done using MAPLE. Modeling projects in the course will emphasize the use of MAPLE to do the heavy lifting. Quantitative Literacy and Writing are significant components of this course. This course meets the Core Curriculum requirements for Area III: Mathematics.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 260. Introduction to Linear Algebra. 3 Hours.
Linear equations and matrices; real vector spaces, basis, diagonalization, linear transformations; determinants, eigenvalues, and eigenvectors; inner product spaces, matrix diagonalization; applications and selected additional topics. MA 260 and MA 434 may not both be counted toward the major or minor. This course meets the Core Curriculum requirements for Area III: Mathematics.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 265. Math Tools for Engineering Problem Solving. 4 Hours.
An applied mathematics course designed to utilize the terminology and problem-solving approaches inherent to engineering, while completing the mathematical preparation of most engineering students. This course includes elements of MA 227 and MA 252.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 268. Introduction to Mathematical Biology. 3 Hours.
This course, designed at the interface of several disciplines, targets undergraduate students in biology, mathematics, and engineering. We will review the biology of problems that arise in nature and medicine and study the mathematics that allows us to tackle these problems. This course serves as an introduction, by example, to multivariable calculus, discrete and continuous differential equations in one or more variables, vectors, matrices, linear and non-linear dynamical systems, and basic concepts of chaos. Biological topics may include single species and interacting population dynamics, modeling infectious and dynamic diseases, regulation of cell function, molecular interactions and receptor-ligand binding, biological oscillators, and an introduction to biological pattern formation. There will also be discussions of current topics of interest such as tumor growth and angiogenesis, HIV and AIDS, and control of the mitotic clock.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 298. Research in Mathematics. 1-12 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics. Freshman or sophomore standing recommended. Prerequisites: Permission of instructor.

MA 311. History of Mathematics I. 3,4 Hours.
Development of mathematical principles and ideas from an historical viewpoint, and their cultural, educational and social significance.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 312. History of Mathematics II. 3 Hours.
Development of mathematical principles and ideas from an historical viewpoint, and their cultural, educational and social significance.
Prerequisites: MA 311 [Min Grade: C]

MA 313. Patterns, Functions and Algebraic Reasoning. 3 Hours.
Problem solving experiences, inductive and deductive reasoning, patterns and functions, some concepts and applications of geometry for elementary and middle school teachers. Topics include linear and quadratic relations and functions and some cubic and exponential functions. Number sense with the rational number system including fractions, decimals, and percents will be developed in problem contexts. An emphasis will be on developing algebraic thinking and reasoning.
Prerequisites: MA 102 [Min Grade: C] or MA 105 [Min Grade: C] or MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 110 [Min Grade: C] or MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 314. Geometric and Proportional Reasoning. 3 Hours.
Problem solving experiences, inductive and deductive reasoning, concepts and applications of geometry and proportional reasoning. Topics include analysis of one-, two- and three-dimensional features of real objects, ratio and proportionally, similarity, and congruence, linear, area, and volume measurement, and the development of mathematically convincing arguments. An emphasis will be on developing geometric and proportional thinking and reasoning.
Prerequisites: MA 313 [Min Grade: C]

MA 315. Probabilistic and Statistical Reasoning. 3 Hours.
Descriptive and inferential statistics, probability, estimation, hypothesis testing. Reasoning with probability and statistics is emphasized.
Prerequisites: MA 313 [Min Grade: C]

MA 316. Numerical Reasoning. 3 Hours.
Develop an understanding of number and improve numerical reasoning skills specifically with regard to place value, number relationship that build fluency with basis facts, and computational proficiency; developing a deep understanding of numerous diverse computational algorithms; mathematical models to represent fractions, decimals and percents, equivalencies and operations with fractions, decimals and percents; number theory including order of operations, counting as a big idea, properties of number, primes and composites, perfect, abundant and significant numbers, and figurate numbers; inductive and deductive reasoning with number.
Prerequisites: MA 313 [Min Grade: C]

MA 317. Extending Algebraic Reasoning. 3 Hours.
Extension of algebraic and functional reasoning to polynomials, rational, exponential, and logarithmic functions; problem-solving involving transfer among representations (equation, graph, table); proof via symbolic reasoning, contradiction, and algorithm; interpretation of key points on graphs (intercepts, slope, extrema); development of facility and efficiency in manipulating symbolic representations with understanding; appropriate use of technology and approximate versus exact solutions; functions as models.
Prerequisites: MA 313 [Min Grade: C]

MA 360. Scientific Programming. 3 Hours.
Programming and mathematical problem solving using Matlab, Python, FORTRAN or C++. Emphasizes the systematic development of algorithms and numerical methods. Topics include computers, floating point arithmetic, iteration, GNU/Linux operating system, functions, arrays, Matlab graphics, image processing, robotics, solving linear systems and differential equation arising from practical situations, use of debuggers and other debugging techniques, and profiling; use of callable subroutine packages like LAPACK and differential equation routines; parallel programming. Assignments and projects are designed to give the students a computational sense through complexity, dimension, inexact arithmetic, randomness, simulation and the role of approximation.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 361. Mathematical Modeling. 3 Hours.
Mathematical modeling using computer software, including spreadsheets, systems dynamics software, and computer algebra systems; connections to calculus and functions are emphasized. Students make presentations to the class; justification of mathematical claims and quality of student presentations are assessed. Quantitative Literacy is a significant component of this course.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 398. Research in Mathematics. 1-12 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Junior standing recommended. Permission of instructor required.

MA 411. Integrating Mathematical Ideas. 3 Hours.
This course will integrate ideas from algebra, geometry, probability, and statistics. Emphasis will be on using functions as mathematical models, becoming fluent with multiple representations of functions, and choosing the most appropriate representations for solving a specific problem. Students will be expected to communicate mathematics verbally and in writing through small group, whole group, and individual interactions.
Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and MA 314 [Min Grade: C](Can be taken Concurrently) or MA 316 [Min Grade: C])

MA 418. Statistics for Teachers. 3 Hours.
Descriptive and inferential statistics, probability distributions, estimation, hypotheses testing, regression. Writing assignment on a project drawing from the above topics. Quantitative Literacy is a significant component of this course.
Prerequisites: MA 102 [Min Grade: C] or MA 105 [Min Grade: C] or MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 110 [Min Grade: C] or MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 419. Special Topics. 1-4 Hour.
Topics vary; may be repeated for credit.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 434. Algebra I: Linear. 3 Hours.
Abstract vector spaces, subspaces, dimension bases, linear transformations, matrix algebra, matrix representations of linear transformations, determinants. MA 260 and MA 434 may not both be counted toward the minor.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 435. Algebra II: Modern. 3 Hours.
Rings, including the rings of integers and of polynomials, integral domains, fields and groups. Homomorphism, isomorphism. As time permits, Galois theory, semi-groups, quotient groups, models, or other areas of algebra may be included. Students present proofs from a list of pre-assigned theorems to the class. Logical correctness and proper mathematical proof-writing style are assessed.
Prerequisites: MA 434 [Min Grade: C] or MA 260 [Min Grade: C]

MA 440. Advanced Calculus I. 3 Hours.
Real numbers, sequences and series, continuity, differential and integral calculus, exponential and logarithm functions, sine and cosine functions. Students present proofs from a list of pre-assigned theorems to the class. Written versions of the proofs are posted for easy access in subsequent proofs. Logical correctness and proper mathematical proof-writing style are assessed. Writing and Quantitative Literacy are significant components of the course.
Prerequisites: MA 227 [Min Grade: C]

MA 441. Advanced Calculus II. 3 Hours.
Real numbers, sequences and series, continuity, differential and integral calculus, exponential and logarithm functions, sine and cosine functions. Students present proofs from a list of pre-assigned theorems to the class. Written versions of the proofs are posted for easy access in subsequent proofs. Logical correctness and proper mathematical proof-writing style are assessed. Writing and Quantitative Literacy are significant components of the course.
Prerequisites: MA 440 [Min Grade: C]

MA 444. Vector Analysis. 3 Hours.
Review and application of multiple integrals; Jacobians and change of variables in multiple integrals; line and surface integrals; Green, Gauss, and Stokes theorems, with applications to physical sciences and computation in spherical and cylindrical coordinates.
Prerequisites: MA 227 [Min Grade: C]

MA 445. Complex Analysis. 3 Hours.
Analytic functions, complex integration and Cauchys theorem, Taylor and Laurent series, calculus of residues and applications, conformal mappings.
Prerequisites: MA 227 [Min Grade: C]

MA 453. Transforms. 3 Hours.
Theory and applications of Laplace and Fourier transforms.
Prerequisites: MA 252 [Min Grade: C]

MA 454. Intermediate Differential Equations. 3 Hours.
Topics from among Frobenius series solutions, Sturm-Liouville systems, nonlinear equations, and stability theory.
Prerequisites: MA 252 [Min Grade: C]

MA 455. Partial Differential Equations I. 3 Hours.
Classification of second order partial differential equations; background on eigenfunction expansions and Fourier series; integrals and transforms; solutions of the wave equations, reflection of waves; solution of the heat equations in bounded and unbounded media; Laplaces equation, Dirichlet and Neumann problems. Written project reports required. Quantitative Literacy and Writing are significant components of this course.
Prerequisites: MA 252 [Min Grade: C]

MA 456. Partial Differential Equations II. 3 Hours.
Classification of second order partial differential equations; background on eigenfunction expansions and Fourier series; integrals and transforms; solution of the wave equations, reflection of waves; solution of the heat equation in bounded and unbounded media; Laplace's equation, Dirichlet and Neumann problems.
Prerequisites: MA 455 [Min Grade: C]

MA 461. Modeling with Partial Differential Equations. 3 Hours.
Practical examples of partial differential equations; derivation of partial differential equations from physical laws; introduction to MATLAB and its PDE Tool-box, and COMSOL using practical examples; an overview of finite difference and finite element solution methods; specialized modeling projects in topics such as groundwater modeling, scattering of waves, medical and industrial imaging, continuum mechanics and deformation of solids, Fluid mechanics including the class boat race, financial derivative modeling, and acoustic and electromagnetic wave applications. Written project reports required for all homework assignments. Quantitative Literacy and Writing are significant components of this course.
Prerequisites: MA 252 [Min Grade: C]

MA 462. Intro to Stochastic Differential Equations. 3 Hours.
Stochastic differential equations arise when random effects are introduced into the modeling of physical systems. Topics include Brownian motion and Wiener processes, stochastic integrals and the Ito calculus, stochastic differential equations, and applications to financial modeling, including option pricing.
Prerequisites: MA 485 [Min Grade: C]

MA 463. Operations Research I. 3 Hours.
Mathematical techniques and models with application in industry, government and defense. Topics usually chosen from dynamic, linear, and nonlinear programming; decision theory; Markov chains; queuing theory; inventory control; simulation; network analysis; and selected case studies.
Prerequisites: MA 227 [Min Grade: C]

MA 464. Operations Research II. 3 Hours.
Mathematical techniques and models with application in industry, government, and defense. Topics usually chosen from dynamic, linear, and nonlinear programming; decision theory; Markov chains; queuing theory; inventory control; simulation; network analysis; and selected case studies.
Prerequisites: MA 463 [Min Grade: C]

MA 465. Partial Differential Equations: Finite Diff. Meth.. 3 Hours.
Review of difference methods for ordinary differential equations, including Runge-Kutta, multi-step, adaptive stepsizing, and stiffness; finite difference versus finite element; elliptic boundary value problems, iterative solution methods, self-adjoint elliptic problems; parabolic equations, including consistency, stability, and convergence, Crank-Nicolson method, method of lines; first order hyperbolic systems and characteristics, Lax-Wendroff schemes, method of lines for hyperbolic equations.
Prerequisites: MA 360 [Min Grade: C] and MA 455 [Min Grade: C]

MA 467. Gas Dynamics. 3 Hours.
Euler's equations for inviscid flows, rotation and vorticity, Navier-Stokes equations for viscous flows, hyperbolic equations and characteristics, rarefaction waves, shock waves and entropy conditions, the Riemann problem for one-dimensional gas flows, numerical schemes.
Prerequisites: MA 252 [Min Grade: C] and MA 360 [Min Grade: C]

MA 468. Numerical Analysis. 3 Hours.
Introduction to Matlab, integration, interpolation, rational approximation, splines, numerical methods for ordinary differential equations, ordinary differential equation modeling, minimization of functions.
Prerequisites: MA 227 [Min Grade: C] or MA 252 [Min Grade: C]

MA 469. Numerical Analysis II. 3 Hours.
Integrals, interpolation, rational approximation, numerical solution of ordinary differential equations, iterative solution of algebraic equations in single variable, least squares. Gaussian elimination of solution of linear equations.
Prerequisites: MA 468 [Min Grade: C]

MA 470. Differential Geometry I. 3 Hours.
Theory of curves and surfaces: Frenet formulas for curve, first and second fundamental forms of surface; global theory; abstract surfaces, manifolds, Riemannian geometry.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 471. Differential Geometry II. 3 Hours.
Theory of curves and surfaces: Frenet formulas for curve, first and second fundamental forms of surface; global theory; abstract surfaces, manifolds, Riemannian geometry.
Prerequisites: MA 470 [Min Grade: C]

MA 472. Geometry I. 3 Hours.
The axiomatic method; Euclidean geometry including Euclidean constructions, basic analytic geometry, transformational geometry, and Klein's Erlangen Program. Students present proofs from a list of pre-assigned theorems to the class. Logical correctness and proper mathematical proof-writing style are assessed.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 473. Geometry II. 3 Hours.
Analytical geometry, Birkhoff s axioms, and the complex plane; structure and representation of Euclidean isometries; plane symmetries; non-Euclidean(hyperbolic) geometry and non-Euclidean transformations; fractal geometry; algorithmic geometry. Course integrates intuition/ exploration and proof/ explanation.
Prerequisites: MA 472 [Min Grade: C] and (MA 260 [Min Grade: C] or MA 434 [Min Grade: C])

MA 474. Introduction to Topology I. 3 Hours.
Essence and consequences of notion of continuous function developed. Topics include metric spaces, topological spaces, compactness, connected-ness, and separation.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 475. Introduction to Topology II. 3 Hours.
Essence and consequences of notion of continuous function developed. Topics include metric spaces, topological spaces, compactness, connectedness, and separation.
Prerequisites: MA 474 [Min Grade: C]

MA 480. Introduction to Statistics. 3 Hours.
Descriptive and inferential statistics, probability distributions, estimation, hypothesis testing. Recommended that two years of high school algebra or MA 102 has been completed before taking course.

MA 484. Mathematical Finance. 3 Hours.
The notion of no arbitrage. Interest, compounding, bonds. Review of mean, variance, and covariance. Portfolio management: risk and return. Forwards and Futures. Put-call parity. Martingales and conditional expectation. The binomial model. Fundamental theorems of asset pricing. Brownian motion (heuristics). Ito's formula and Girsanov's theorem (heuristics). The Black-Scholes-Merton formula. Interest rates. The binomial model for stochastic interest rates.
Prerequisites: (MA 434 [Min Grade: C] or MA 435 [Min Grade: C] or MA 260 [Min Grade: C]) and (MA 485 [Min Grade: C] or MA 585 [Min Grade: C])

MA 485. Probability. 3 Hours.
Probability spaces, combinatorics, conditional probabilities and independence, Bayes rule, discrete and continuous distributions, mean value and variance, moment generation function, joint distributions, correlation, Central Limit Theorem, Law of Large Numbers, random walks, Poisson process.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

MA 486. Mathematical Statistics. 3 Hours.
Sampling techniques and data analysis, Simulation, Point estimation, Confidence intervals, Sufficient statistics, Rao-Cramer lower bound, Tests for binomials, Tests for normals, Goodness-of-_t test, Contingency tables, Two factor analysis, Regression, Order statistics, Nonparametric methods: Wilcoxon test, Run test, and Kolmogorov-Smirnov test. A computer project that involves a written report. Quantitative Literacy and Writing are significant components of this course.
Prerequisites: MA 485 [Min Grade: C]

MA 490. Mathematics Seminar. 1-3 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites Permission of instructor.

MA 491. Special Topics in Mathematics. 1-3 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 492. Special Topics in Mathematics. 1-3 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 493. Special Topics in Mathematics. 1-3 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 494. Special Topics in Mathematics. 1-6 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 495. Special Topics in Mathematics. 1-6 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 496. Special Topics in Mathematics. 1-12 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics.

MA 497. Research Methods in Mathematics. 1-3 Hour.
Through experience in designing and carrying out investigations, learn how scientists and mathematicians gain knowledge, evaluate scientific and mathematical claims when they conduct, and design and carry out investigations to answer new questions. Work is closely coordinated with the work of students from other content disciplines so that students see the similarity and differences of research methods in their own field as compared with those of science and mathematics inquiry as a whole. Enrollment in UABTeach is required.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

MA 498. Research in Mathematics. 1-12 Hour.
This course covers special topics in mathematics and the applications of mathematics. May be repeated for credit when topics vary. Prerequisites vary with topics. Senior standing recommended.

MA 499. Honors Research in Mathematics. 1-12 Hour.
Mentored research in mathematics leading to a written research report and a public presentation in the form of a talk or poster. Admission restricted to students admitted to Honors in Mathematics. Permission of instructor required.