

## Mathematics

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### Mission:

The Norwich University Department of Mathematics seeks to promote interest in mathematics and to serve as a resource for the university community on current advances in mathematical knowledge and application. The department educates mathematics majors in preparation for civilian or military careers, and for future study in graduate schools.

The department seeks to accomplish this mission through the following activities:

- offering a sequence of courses that introduce undergraduate students in the liberal arts and social sciences to the techniques, methods, and applicability of mathematics;
- offering a basic calculus sequence to provide computer science, mathematics, science, and engineering students with the tools of mathematical analysis;
- offering introductory calculus and quantitative analysis courses to support major programs in architecture, accounting and business administration;
- integrating the use of technology in mathematics education as a tool for solving applied problems;
- offering advanced courses in mathematical theory and application leading to a major in mathematics for a Bachelor of Science degree in mathematics;
- offering a minor in mathematics that complements the major programs of study that a student may select;
- engaging students in experiential education opportunities including undergraduate research, independent study and pre-professional activities;

- offering colloquia and seminars to promote dialogue between members of the department and others of the university community;
- offering math education coursework to support students seeking secondary education licensure;
- offering financial mathematics coursework to support students seeking employment in actuarial science.

### Goals:

- Prepare mathematics majors for graduate work in mathematics or careers in computer science, engineering, industry, business, actuary science, or teaching;
- Support the curricula in all disciplines;
- Supply the students with the mathematics courses necessary to qualify for teacher licensure.

### Outcomes:

- Graduates will have the ability to formulate problems in the application of mathematics to various disciplines, and analyze, solve, and model solutions to these problems.
- Graduates will have a good understanding and broad knowledge of mathematics including single and multivariable calculus, linear and abstract algebra. Students will demonstrate competency in theoretical, applied, routine, and non-routine problems.
- Graduates will be prepared for successful employment in a profession employing mathematics or a profession of their choice and be well prepared for graduate or professional school.

### Careers for this Major:

- Mathematician
- Statistician
- Actuary
- Data Scientist
- University Professor
- Finance
- Government

### B.S. in Mathematics - Curriculum Map

<b>Freshman</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
EN 101 Composition and Literature I	3	EN 102 Composition and Literature II	3
General Education Lab Science	4	General Education Lab Science	4
MA 121 Calculus I (General Education Math) <sup>c1</sup>	4	MA 122 Calculus II (General Education Math) <sup>c1</sup>	4
Free Elective	3	MA 241 Mathematical Computation and Modeling	3
	<b>14</b>		<b>14</b>
<b>Sophomore</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
EN 201 World Literature I (General Education Literature)	3	EN 202 World Literature II	3
General Education History <sup>1</sup>	3	General Education Arts & Humanities	3
MA 223 Calculus III <sup>c1</sup>	4	MA 224 Differential Equations <sup>c1</sup>	4
MA 306 Discrete Mathematics <sup>c2</sup>	3	MA 310 Linear Algebra <sup>c2</sup>	3
PS 211 University Physics I	4	PS 212 University Physics II	4
	<b>17</b>		<b>17</b>
<b>Junior</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
General Education Social Science	3	MA 304 Advanced Calculus II or 312 Statistical Methodology II <sup>3</sup>	3
MA 303 Advanced Calculus I or 309 Algebraic Structures <sup>2, c2</sup>	3	Math Elective (300-400 level) <sup>c2</sup>	3
MA 311 Statistical Methodology <sup>c2</sup>	3	Math Elective (300-400 level) <sup>c2</sup>	3
Free Elective	3	PH 303 Survey of Ethics or 350 Medical Ethics (General Education Ethics)	3
Free Elective	3	Free Elective	3
		MA 250 Communication in Mathematics	1
	<b>15</b>		<b>16</b>
<b>Senior</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
MA 309 Algebraic Structures or 303 Advanced Calculus I <sup>2, c2</sup>	3	Mathematics Elective (300-400 level) <sup>c2</sup>	3
MA 411 Senior Seminars <sup>c2</sup>	3	Mathematics Elective (300-400 level) <sup>c2</sup>	3
Free Elective	3	Free Elective	3
Free Elective	3	Free Elective	3
Free Elective	3	Free Elective	3
	<b>15</b>		<b>15</b>
<b>Total Credits: 123</b>			

<sup>2</sup> MA 303 and MA 309 alternate as fall semester courses; both courses are required. For years these courses are offered, see Course Descriptions.

<sup>3</sup> MA 304 and MA 312 alternate as spring semester courses; one of the two courses is required.

<sup>c1</sup> Grade of C or higher required in 3 of the 4 courses.

<sup>c2</sup> Grade of C or higher in at least 6 Math courses at the 300/400 level (other than MA 360)

### **B.S. in Mathematics-Actuarial Science Concentration - Curriculum Map**

<b>Freshman</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
EN 101 Composition and Literature I	3	EN 102 Composition and Literature II	3
General Education History <sup>1</sup>	3	General Education Lab Science	4
General Education Lab Science	4	MA 122 Calculus II (General Education Math) <sup>c1</sup>	4
MA 121 Calculus I (General Education Math) <sup>c1</sup>	4	MA 241 Mathematical Computation and Modeling	3
	<b>14</b>		<b>14</b>
<b>Sophomore</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
EC 201 Principles of Economics (Macro) (General Education Social Science) <sup>b,c</sup>	3	EC 202 Principles of Economics (Micro) <sup>b,c</sup>	3
EN 201 World Literature I (General Education Literature)	3	EN 202 World Literature II	3
MA 223 Calculus III <sup>c1</sup>	4	MA 224 Differential Equations <sup>c1</sup>	4
MA 306 Discrete Mathematics	3	MA 310 Linear Algebra	3
PS 211 University Physics I	4	PS 212 University Physics II	4
	<b>17</b>		<b>17</b>
<b>Junior</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
General Education Arts & Humanities	3	MA 312 Statistical Methodology II <sup>b,c</sup>	3
MA 212 Finite Mathematics <sup>c</sup>	3	Mathematics Elective	3
MA 303 Advanced Calculus I or 309 Algebraic Structures <sup>2</sup>	3	Mathematics Elective	3
MA 311 Statistical Methodology <sup>b,c</sup>	3	PH 303 Survey of Ethics or 350 Medical Ethics (General Education Ethics)	3
Free Elective	3	Free Elective	3
		MA 250 Communication in Mathematics	1
	<b>15</b>		<b>16</b>
<b>Senior</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
MA 309 Algebraic Structures or 303 Advanced Calculus I <sup>2</sup>	3	MA 321 Financial Mathematics <sup>c</sup>	3
MA 411 Senior Seminars	3	Mathematics Elective	3
Free Elective	3	Free Elective	3
Free Elective	3	Free Elective	3
Free Elective	3	Free Elective	3
	<b>15</b>		<b>15</b>
<b>Total Credits: 123</b>			

<sup>2</sup> MA 303 and MA 309 alternate as fall semester courses; both courses are required. For years these courses are offered, see Course Descriptions.

<sup>b</sup> Grade of B- or higher to meet the Society of Actuaries Validation by Educational Experience requirement.

<sup>c</sup> Grade of C or higher required.

<sup>c1</sup> Grade of C or higher required in 3 of the 4 courses.

## **B.S. in Mathematics-Education Concentration - Curriculum Map**

<b>Freshman</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
ED 104 Foundations of Education	3	EN 102 Composition and Literature II	3
EN 101 Composition and Literature I	3	General Education Lab Science	4
General Education Lab Science	4	MA 122 Calculus II (General Education Math) <sup>c1</sup>	4
MA 121 Calculus I (General Education Math) <sup>c1</sup>	4	MA 241 Mathematical Computation and Modeling	3
PY 211 Introduction to Psychology	3	PY 220 Developmental Psychology	3
	<b>17</b>		<b>17</b>
<b>Sophomore</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
ED 234 Learning and Teaching Strategies	4	EN 202 World Literature II	3
EN 201 World Literature I (General Education Literature)	3	MA 224 Differential Equations <sup>c1</sup>	4
MA 223 Calculus III <sup>c2</sup>	4	MA 310 Linear Algebra <sup>c2</sup>	3
MA 306 Discrete Mathematics <sup>c2</sup>	3	PS 212 University Physics II	4
PS 211 University Physics I	4	ED 315 Special Needs Child	3
	<b>18</b>		<b>17</b>
<b>Junior</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
General Education History	3	ED 363 Reading and Writing in the Content Area	4
MA 303 Advanced Calculus I or 309 Algebraic Structures <sup>1, c2</sup>	3	General Education Arts & Humanities	3
MA 311 Statistical Methodology <sup>c2</sup>	3	Mathematics Elective	3
PY 324 Adolescent Psychology	3-4	Mathematics Elective	3
PY 352 Learning and Memory	4	MA 304 Advanced Calculus II or 312 Statistical Methodology II <sup>2</sup>	3
MA 361 Teaching Mathematics at the Secondary Level (OR Mathematics Elective)	3	MA 250 Communication in Mathematics	1
	<b>19-20</b>		<b>17</b>
<b>Senior</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
ED 368 Curriculum & Methods in Secondary Subjects	4	ED 425 Student Teaching	12
General Education Philosophy	3		
MA 309 Algebraic Structures or 303 Advanced Calculus I <sup>1, c2</sup>	3		
MA 411 Senior Seminars <sup>c2</sup>	3		
MA 361 Teaching Mathematics at the Secondary Level (OR Mathematics Elective)	3		
	<b>16</b>		<b>12</b>
<b>Total Credits: 133-134</b>			

<sup>1</sup> MA 303 and MA 309 alternate as fall semester courses; both courses are required. For years these courses are offered, see Course Descriptions.

<sup>2</sup> MA 304 and MA 312 alternate as spring semester courses; one of the two courses is required.

<sup>c1</sup> Grade of C or higher required in 3 of the 4 courses.

<sup>c2</sup> Grade of C or higher in at least 6 Math courses at the 300/400 level (other than MA 360).

### Mathematics Minor

Students self-design this minor so the classes chosen blend with their major, with the advice of the Math Department.

All courses require a grade of C or higher.

Math Elective (higher than MA 121)	3
Math Elective (higher than MA 121)	3
Math Elective (higher than MA 121)	3
Math Elective (300-400 level)	3
Math Elective (300-400 level)	3
Math Elective (300-400 level)	3
<b>Total Credits</b>	<b>18</b>

## Courses

### MA 005 Preparatory Mathematics 3 Credits

A comprehensive review of the fundamentals of arithmetic and a presentation of the basic algebraic skills and concepts. Topics include basic arithmetic with signed numbers, proportions, percent, geometry, linear equations and graphing of linear equations. Applications are included throughout the course. Students assigned to MA005 must satisfactorily complete it before enrolling in any other mathematics course. If required, MA005 must be completed by the end of the first year of study. This course will not meet any degree requirements and cannot be used as an elective. 3 lecture hours.

### MA 101 Mathematics: A Liberal Art 3 Credits

An investigation of mathematical concepts and methods with emphasis given to their impact on current and ancient problems. Topics include logic, counting problems, probability, geometry and mathematics of finance. Emphasis is on techniques of problem solving. Prerequisite: Satisfactory completion of MA 005 or equivalent as determined by departmental placement testing. Not open for the first time to a student with a grade of "C" or higher in MA 107, or with credit for any mathematics course requiring MA 107 as a prerequisite. Offered fall semesters.

### MA 102 Mathematics: A Liberal Art 3 Credits

An investigation of mathematical concepts and methods with emphasis given to their impact on current and ancient problems. Topics include mathematics of voting systems, basic graph theory including Euler circuits and the traveling salesman problem, the mathematics of population growth, statistics, and finding fair shares. Emphasis is on techniques of problem solving. Prerequisite: Satisfactory completion of MA 005 or equivalent as determined by departmental placement testing. Not open for the first time to a student with a grade of "C" or higher in MA 107, or with credit for any mathematics course requiring MA 107 as a prerequisite. Offered spring semesters.

### MA 103 College Algebra I 3 Credits

A comprehensive study of algebraic topics, this course provides a strong foundation for subsequent mathematics-based courses. Topics include introduction to functions, polynomials, factoring, inequalities, systems of linear equations with two variables, integer exponents, and linear, quadratic, radical, and rational equations. Prerequisite: Grade of "C" or better in MA 005 or equivalent as determined by departmental placement testing. Not open for the first time to students who have received degree credit in any math course except MA 101, MA 102. This course does not fulfill the General Education requirement in mathematics. 3 lecture hours.

### MA 107 Precalculus Mathematics 4 Credits

A course on topics in precalculus mathematics involving algebra and trigonometry designed to prepare students to progress into introductory calculus. It is a rapid development of elementary topics in algebra to linear, quadratic, logarithmic, and exponential functions, followed by an analytical treatment of trigonometry. Prerequisite: Grade of "C" or better in MA 103 or equivalent as determined by departmental placement testing. Not open for the first time to students with credit in any course requiring MA 107 as a prerequisite.

### MA 108 Applied Calculus 4 Credits

A course on topics in analytical geometry progressing to differential and integral calculus. Presentation of a wide variety of practical application to technology, business, and science. Not open for the first time to a student with credit in MA 121 or any course requiring MA 108 as a prerequisite. Prerequisite: MA 107 or equivalent as determined by departmental placement testing. Not more than one of MA 108 or MA 121 may count as degree credit.

### MA 121 Calculus I 4 Credits

An introduction to plane analytic geometry and to differential and integral calculus. Prerequisite: grade of "C" or better in MA 107 or equivalent as determined by departmental placement testing. Not more than one of MA 108 or MA 121 may count as degree credit.

### MA 122 Calculus II 4 Credits

A continuation of MA 121. Transcendental functions, methods of integration, vectors, polar coordinates, indeterminate forms, L'Hopital's Rule, improper integrals, infinite sequences and series. Prerequisite: MA 121 or "C" or better in MA 108 and permission of the department.

### MA 160 Mathematics for Elementary School Teachers I 3 Credits

This course will address an advanced perspective of topics in algebra and the real number system as they relate to the teaching and learning of mathematics. Course structure involves an emphasis on problem solving and communication; making, following and assessing mathematical argument; and developing an array of mathematical strategies and understandings which can be extended across K-6 mathematics. This course is open to education majors. Prerequisite: Satisfactory completion of MA 005 or equivalent as determined by departmental placement testing. Offered fall semesters of odd years. 3 lecture hours. This course does not meet Gen Ed Math requirements.

### MA 161 Mathematics for Elementary School Teachers II 3 Credits

This course will address an advanced perspective of topics in geometry, measurement, statistics, data analysis, and probability as they relate to the teaching and learning of mathematics. Course structure involves an emphasis on problem solving and communication; making, following and assessing mathematical argument; and developing an array of mathematical strategies and understandings which can be extended across K-6 mathematics. Prerequisite: Grade of C or better in MA 160. Offered spring semesters of odd years. 3 lecture hours.

### MA 212 Finite Mathematics 3 Credits

This course includes linear algebra with applications to systems of equations, linear programming, math of finance, sets, combinatorial analysis, and probability theory. Prerequisite: MA 107 or equivalent as determined by department placement testing. Offered spring semesters.

**MA 220 Geometry in Action 3 Credits**

This course explores the use of geometry in art, architecture, and science through the study and application of associated mathematical ideas. Students will learn to represent objects and space in various coordinate systems and geometries as well as recognize mathematics in the surrounding world. Topics include two and three dimensional linear algebra, polar and parametric equations, graph theory, sequences, and Euclidean and Non-Euclidean geometry. Prerequisite: MA 107 or permission of the department.

**MA 223 Calculus III 4 Credits**

A course that continues MA 122. Topics include multiple integration, solid analytic geometry, partial differentiation, two- and three- dimensional vector analysis. Prerequisite: MA 122. Offered fall semesters.

**MA 224 Differential Equations 4 Credits**

Ordinary differential equations are developed as models of physical phenomena. Differential equations are investigated by finding exact solutions and using computer software to determine the solution to linear and non-linear problems. Solution techniques include operator methods, Laplace transforms, and numerical methods. Prerequisite: MA 122. Offered spring semesters.

**MA 232 Elementary Statistics 3 Credits**

A course that covers the study of frequency distributions, averages and standard deviations, normal curve, probability, decision-making, sampling techniques, testing hypotheses, chi-square, students-t and F-distributions, correlation and linear regression. This course is valuable for those who plan to enter teaching. Prerequisite: A college level mathematics course or equivalent as determined by departmental placement testing. Not open to students with credit in MA 311.

**MA 235 Clinical Mathematical Methods 3 Credits**

A course investigating mathematical concepts and methods used in the health care settings. This course will cover the essential math for medication calculations, the continued development of statistical techniques utilized in scientific research, and the mathematics of population dynamics and epidemiological studies. Case studies will be used where appropriate. Emphasis will be on critical thinking and logic of math in a health care environment and in health care research and administration. This is a mathematics course for Nursing Majors. Prerequisites: MA 232. Offered Fall semesters. 3 lecture hours and 1 laboratory hour. 3 credits.

**MA 240 Introduction to Number Theory and Cryptology 3 Credits**

An introduction to fundamental topics in number theory, including the real number system, prime numbers, modular arithmetic, the Euclidean Algorithm, Fermat's Theorem, Euler's Theorem, Euler's Phi Function. Topics will be applied to Caesar and affine ciphers and the Chinese Remainder Theorem. Prerequisite: MA 107 and knowledge of a programming language or permission of the instructor. Offered fall semesters.

**MA 241 Mathematical Computation and Modeling 3 Credits**

A course designed to introduce effective problem solving strategies and modeling techniques to find solutions to complex and often ill-defined problems. Introductory material chosen from common experiences encompassing many academic disciplines. Emphasis is placed on the development of mathematical models and computation on a variety of computing platforms and programming environments. Prerequisite: MA 108, MA 121 or permission of instructor. Offered spring semesters.

**MA 250 Communication in Mathematics 1 Credit**

This course illustrates the organization of the mathematical literature, the efficient search of the literature and a formal introduction to writing mathematics. Prerequisite: Sophomore Mathematics Major or permission of the instructor.

**MA 303 Advanced Calculus I 3 Credits**

A course that provides an extension of concepts of basic calculus to functions of several variables to include limits, continuity, differentiation, and Riemann integration. Treatment of selected topics not included in the basic calculus series as a foundation for more advanced courses in analysis and applied mathematics is also included. Prerequisite: MA 223 and either MA 306 or permission of the instructor. Offered Fall semesters of even numbered years. 3 lecture hours.

**MA 304 Advanced Calculus II 3 Credits**

A course that continues with the content of MA 303, including limits, continuity, differentiation, and Riemann integration. Treatment of selected topics not included in the basic calculus series as a foundation for more advanced courses in analysis and applied mathematics is also included. Prerequisite: MA 303. Offered Spring semesters of odd numbered years.

**MA 306 Discrete Mathematics 3 Credits**

A course in logic, sets, techniques of proof, relations and functions, directed and undirected graphs, algebraic systems, Boolean algebra, and emphasis on applications in various areas of computer science. Prerequisite: MA 108 or MA 121 and knowledge of computer programming. Offered fall semesters.

**MA 308 Modern Geometry 3 Credits**

A course in modern geometries that includes foundations of Euclidean geometry and the development of non-Euclidean geometries. Recommended for prospective teachers. Prerequisite: MA 108 or MA 121. Offered Spring 2010 and every third year. 3 lecture hours.

**MA 309 Algebraic Structures 3 Credits**

A course on groups, rings, fields, morphisms, vector spaces; special topics selected from group theory, algebraic number theory, field theory, Galois theory. Prerequisite: MA 306 or permission of the instructor. Offered Fall semesters of odd numbered years. 3 lecture hours.

**MA 310 Linear Algebra 3 Credits**

A theoretical course on such topics as matrices, determinants, linear equations, vector spaces, bases and dimensions, linear transformations, eigenvalues, and eigenvectors. Prerequisite: MA 223 or permission of the instructor. Offered spring semesters.

**MA 311 Statistical Methodology 3 Credits**

A course designed to provide a firm foundation for the employment of statistical methodology in engineering and the sciences. Examples drawn from the technical fields will be used throughout. The course will cover probability, continuous and discrete statistical distributions, estimation, tests of hypotheses, and sample regression. As time permits, other topics may be examined based on the interests of the students. Prerequisite: MA 223. Offered fall semesters. 3 lecture hours.

**MA 312 Statistical Methodology II 3 Credits**

A continuation of MA 311. Continued development of statistical techniques utilized in scientific and engineering research. Topics to be covered include regression, multiple regression, analysis of variance, experimental design, statistical quality control, time series/forecasting, and reliability analysis. Prerequisite: MA 311. Offered Spring semesters of even numbered years. 3 lecture hours.



**MA 318 Cryptology 3 Credits**

A course that covers fundamental mathematical concepts from modern algebra, number theory, and other areas of mathematics. Provides a foundation for the understanding of classical encryption systems and modern encryption methods. Emphasis on the mathematical underpinnings germane to cryptology. Prepares students for advanced study of modern cryptography. Experience implementing encryption, decryption and cryptanalytic methods on a variety of systems.

Prerequisite: MA 240 and knowledge of a programming language or permission of instructor. Offered spring semesters. 3 lecture hours.

**MA 321 Financial Mathematics 3 Credits**

A course designed to extend the student's understanding of the fundamental concepts of financial mathematics, and application of these concepts in calculating present and accumulated values for various streams of cash flows as a basis for future use in reserving, valuation, pricing, asset/liability management, investment income, capital budgeting and valuing contingent cash flows. The student will also be given an introduction to financial instruments, including derivatives, and the concept of no-arbitrage as it relates to financial mathematics. Offered Spring semesters of odd years. Prerequisites: MA 121 or MA 108, and MA 212. 3 lecture hours.

**MA 360 Teaching Mathematics at the Elementary - Middle School Level 3 Credits**

A course in the content, methods, and materials for the teaching of elementary and middle school mathematics. Prerequisites: grade of C or higher in MA 161. 3 lecture hours.

**MA 361 Teaching Mathematics at the Secondary Level 3 Credits**

This course addresses methods, resources, and content useful for the teaching of secondary school mathematics. Investigations in this class will address mathematical thinking, communication and representations, in alignment with state and national standards. Course structure involves readings, writings, activities, assessments, and projects. Prerequisites: MA 108 or MA 121 and ED 104, or consent of instructor. Offered Fall semesters of odd numbered years. 3 lecture hours.

**MA 370 Introduction to Operations Research 3 Credits**

A course that concentrates on the fundamental concepts and techniques necessary to enable an individual to obtain "optimal" solutions to problems in business, economics, engineering, and the physical and behavioral sciences. Topics include linear programming, network analysis, dynamic programming. Prerequisites: MA 212 or MA 223. Offered Spring semesters of odd numbered years. 3 lecture hours.

**MA 380 Theory of Computation 3 Credits**

This course introduces the theory of computability, including important results from the study of automata and formal languages. Includes introductory material about the theory of directed graphs and trees. A discussion of automata and their relationship to regular, context free and context-sensitive languages. General theories of computability, including Turing machines, and recursive functions. Further topics include decidability, undecidability and computational complexity. Prerequisite: MA 306. Offered Spring semesters of even numbered years. 3 lecture hours.

**MA 390 Numerical Linear Algebra and Analysis 3 Credits**

Numerical techniques for solving problems in linear algebra and analysis. Topics to be studied include integration, interpolation, function approximation, solutions of systems of equations, locating Eigen values. Attention will be paid to the theoretical aspects of the techniques, with particular emphasis on estimation of errors and on convergence properties of iterative techniques. Prerequisites: MA 241, MA 224. Offered Spring 2009 and every third year. 3 lecture hours.

**MA 399 Mathematical Problem Solving 3 Credits****MA 405 Complex Analysis 3 Credits**

A course in complex numbers, analytic functions, differentiation, and integration of complex functions, Taylor and Laurent series, evaluation of improper real integrals. Prerequisites: MA 223 and either MA 306 or permission of the instructor. Offered Spring 2011 and every third year. 3 lecture hours.

**MA 407 Vector Analysis 3 Credits**

A course that analyzes scalar and vector fields. Topics included are Newtonian kinematics and Kepler's Law of Planetary Motion, gradient, divergence, curl, theorems of Green, Stokes, Gauss, curvilinear coordinates. Prerequisite: MA 223. Offered Fall 2009 and every third year. 3 lecture hours.

**MA 411 Senior Seminars 3 Credits**

Advanced study designed to develop student competence in working independently and to afford students an opportunity to pursue topics not otherwise offered by the department. Prerequisite: senior standing in mathematics or permission of the instructor. This is the capstone course for the Mathematics Major. 3 lecture hours.

**MA 412 Senior Seminars 3 Credits**

Advanced study designed to enhance student competence in working independently and to afford students an opportunity to pursue topics not otherwise offered by the department. Topics may extend research performed in MA 411 or be a topic independent of MA 411. Prerequisite: MA 411. 3 lecture hours.

**MA 421 Number Theory 3 Credits**

A course in the properties of integers, prime numbers, congruencies, Diophantine equations, quadratic reciprocity. Prerequisite: MA 306 or permission of the instructor. Offered Spring 2011 and every third year. 3 lecture hours.