Mathematics (MATH)

MATH _0110: Intermediate Algebra
MATH _0110 is a preparatory course for college algebra that carries no credit towards any baccalaureate degree. However, the grade received in MATH _0110 does count towards a student's overall GPA. The course covers operations with real numbers, graphs of functions, domain and range of functions, linear equations and inequalities, quadratic equations; operations with polynomials, rational expressions, exponents and radicals; equations of lines. Emphasis is also put on problem-solving.

Credit Hours: 3

MATH 1050: Quantitative Reasoning
Promotes mathematical literacy among students. This course will cover important mathematical ideas and problem solving skills in the context of science, technology, and/or society. Topics may include: logic and critical thinking, Venn Diagrams, problem solving, sets, units of measure, percentages and ratios, counting and probability, exponential growth and decay, linear and exponential models. Quantitative Reasoning is designed to stimulate interest in and appreciation of mathematics and quantitative reasoning as valuable tools for comprehending the world in which we live. This course does not satisfy the prerequisite of any other MATH course.

Credit Hours: 3
Prerequisites: C- or higher in MATH _0110 or a sufficient score on the myMath test
MATH 1050 - MOTR MATH 120: Mathematical Reasoning Modeling

MATH 1100: College Algebra
A review of exponents, order of operations, factoring, and simplifying polynomial, rational, and radical expressions. Topics include: linear, quadratic, polynomial, rational, inverse, exponential, and logarithmic functions and their applications. Students will solve equations involving these functions, and systems of linear equations in two variables, as well as inequalities. See the Math website for specific requirements. A student may receive at most 5 credit hours among MATH 1100, MATH 1120, MATH 1140, and MATH 1160.

Credit Hours: 3
Prerequisites: C- or higher in MATH _0110 or a sufficient score on the ALEKS exam or MyMathTest Intermediate Algebra score of 70% or higher
MATH 1100 - MOTR MATH 120: Mathematical Reasoning Modeling

MATH 1140: Trigonometry
A student may receive only 5 credits from among MATH 1100, MATH 1140, and MATH 1160. A Student may receive at most 5.0 credit hours from MATH 1100, MATH 1120, MATH 1140, and MATH 1160.

Credit Hours: 2
Prerequisites: C- or higher in MATH 1100 or sufficient ALEKS score or MyMathTest College Algebra score of 70% or higher

MATH 1160: Precalculus Mathematics
Review of elementary algebra. Background material for MATH 1500, including algebraic, trigonometric, logarithmic, exponential functions. A student may receive at most 5 credits from among MATH 1100, MATH 1140, and MATH 1160.

Credit Hours: 5
Prerequisites: B- or higher in MATH _0110 (at MU), or C- or higher in MATH 1100, or sufficient ALEKS score or MyMathTest College Algebra score of 60% or higher
MATH 1160 - MOTR MATH 150: Pre-Calculus

MATH 1300: Finite Mathematics
A selections of topics in finite mathematics such as: basic financial mathematics, counting methods and basic probability and statistics, systems of linear equations and matrices. Warning: without a College Algebra exemption, a sufficient ALEKS score will not suffice unless it is a proctored exam (for MATH 1100 credit).

Credit Hours: 3
Prerequisites: Grade of C- or higher in MATH 1100, or MATH 1160, or both a College Algebra exemption and sufficient ALEKS score

MATH 1360: Geometric Concepts
This course is primarily for education majors. This course covers topics of Euclidean geometry such as the study of points, lines, angles, polygons, circles, congruence, similarity, transformations, symmetry, area, surface area, arc length, and volume. Polyhedra, spheres, cones, and other solids are discussed. The course includes constructions and proofs, and uses inductive and deductive reasoning throughout. Math Reasoning Proficiency Course.

Credit Hours: 3
Prerequisites: C- or higher in MATH 1100 or sufficient ALEKS exam score or MATH 1160 or equivalent

MATH 1400: Calculus for Social and Life Sciences I
The real number system, functions, analytic geometry, derivatives, integrals, maximum-minimum problems. No credit for students who have completed a calculus course. A student may receive credit for MATH 1320 or MATH 1400 but not both. A student may receive at most 5 units of credit among the MATH 1320 or MATH 1400 and MATH 1500. Math Reasoning Proficiency Course.

Credit Hours: 3
Prerequisites: grade of C- or higher in MATH 1100, or MATH 1160, or sufficient ALEKS score

MATH 1500: Analytic Geometry and Calculus I
Elementary analytic geometry, functions, limits, continuity, derivatives, antiderivatives, definite integrals. A student may receive at most 5 units of credit among the Mathematics courses MATH 1320 or MATH 1400 and MATH 1500. Math Reasoning Proficiency Course.

Credit Hours: 5
Prerequisites: grade of C- or higher in MATH 1160 or C - or higher in both MATH 1100 and MATH 1140 or sufficient ALEKS score or MyMathTest PreCalculus score of 70% or higher

MATH 1500H: Analytic Geometry and Calculus I - Honors
Elementary analytic geometry, functions, limits, continuity, derivatives, antiderivatives, definite integrals. Honors eligibility required. A student may receive at most 5 units of credit among MATH 1320 or MATH 1400 and MATH 1500. Math Reasoning Proficiency course.
Mathematics (MATH)

Credit Hours: 5
Prerequisites: C- or higher in MATH 1160 or C- in both MATH 1100 and MATH 1140 and sufficient ALEKS score. Honors Eligibility required

MATH 1601: Selected Topics in Mathematics-General
The special topics covered may vary from term to term. This course may be repeated.
Credit Hour: 1-3
Prerequisites: instructor's consent

MATH 1602: Selected Topics in Mathematics-Biological/Physical/Math
The special topics covered may vary from term to term. This course may be repeated.
Credit Hour: 1-3
Prerequisites: instructor's consent

MATH 1700: Calculus II
Definite integrals, applications and techniques of integration, elementary transcendental functions, infinite series. Math Proficiency Reasoning course.
Credit Hours: 5
Prerequisites: a grade of C- or better in MATH 1500

MATH 1700H: Calculus II - Honors
Definite integrals, applications and techniques of integration, elementary transcendental functions, infinite series. Math Reasoning Proficiency course.
Credit Hours: 5
Prerequisites: a grade of C- or better in MATH 1500. Honors eligibility required

MATH 2100: Calculus for Social and Life Sciences II
Riemann integral, transcendental functions, techniques of integration, improper integrals and functions of several variables. No credit for students who have completed two calculus courses. Math Reasoning Proficiency course.
Credit Hours: 3
Prerequisites: C- or higher in MATH 1320 or MATH 1400 or MATH 1500

MATH 2300: Calculus III
Vectors, solid analytic geometry, calculus of several variables. Math Reasoning Proficiency course.
Credit Hours: 3
Prerequisites: grade of C- or better in MATH 1700

MATH 2300H: Calculus III - Honors
Vectors, solid analytic geometry, calculus of several variables. Math Reasoning Proficiency course.
Credit Hours: 3
Prerequisites: grade of C or better in MATH 1700. Honors eligibility required

MATH 2320: Discrete Mathematical Structures
Sets, functions, logic, relations, induction, recursion, counting techniques, graphs, trees, algorithms. Math Reasoning Proficiency course.
Credit Hours: 3
Prerequisites: Grade of C- or higher in MATH 1700

MATH 3000: Introduction to Advanced Mathematics
Gateway to theoretical math courses. Focus on reading and writing math proofs/developing background needed in Adv Calc/Abstract Alg. Topics include logic, set theory, properties of functions and integers, the real number system, completeness of the real numbers, sequences of real numbers.
Credit Hours: 3
Prerequisites: Consent of Department required. Recommended MATH 1700

MATH 3000W: Introduction to Advanced Mathematics - Writing Intensive
Gateway to theoretical math courses. Focus on reading and writing math proofs/developing background needed in Adv Calc/Abstract Alg. Topics include logic, set theory, properties of functions and integers, the real number system, completeness of the real numbers, sequences of real numbers.
Credit Hours: 3
Prerequisites: Consent of Department required. Recommended MATH 1700

MATH 4002: Topics in Mathematics-Biological Sciences
Organized study of selected topics. Subjects and earnable credit may vary from semester to semester. May repeat for credit with Departmental consent.
Credit Hour: 1-6
Prerequisites: MATH 2300 and instructor's consent

MATH 4006: Topics in Mathematics-Mathematical Sciences
Organized study of selected topics. Subjects and earnable credit may vary from semester to semester. May repeat for credit with Departmental consent.
Credit Hour: 1-6
Prerequisites: MATH 2300 and instructor's consent

MATH 4007: Topics in Mathematics-Physical Sciences
Organized study of selected topics. Subjects and earnable credit may vary from semester to semester. May repeat for credit with Departmental consent.
Credit Hour: 1-6
Prerequisites: MATH 2300 and instructor's consent

MATH 4060: Connecting Geometry to Middle and Secondary Schools (cross-leveled with MATH 7060). Euclidean foundations, logic, Euler Characteristic, congruence, area, Pick's Theorem, volume, Cavalieri's Principle, surface area, similarity, symmetry, transformations, matrices, introduction to spherical geometry.
Credit Hours: 3
Prerequisites: Consent of Department required
Recommended: MATH 1360 or MATH 1500

MATH 4070: Connecting Algebra to Middle and Secondary Schools
A detailed study of integer and rational arithmetic and algebra. Topics include: Binomial Theorem, induction, division algorithm, Euclid's Algorithm, Fundamental Theorem of Arithmetic, Pythagorean triples, modular arithmetic and generalizations to polynomials, matrices and other axiomatic structures.
Credit Hours: 3
Prerequisites: MATH 1320, enrollment is restricted to Math Education majors

MATH 4080: Calculus Connections
Course topics include: sequences, series, functions, limits, continuity, differentiation, optimization, curve sketching, antidifferentiation, areas of plane regions, lengths of plane curves, areas of surfaces of revolution, and volumes of solids.
Credit Hours: 3
Prerequisites: MATH 1160, enrollment is restricted to Math Education majors

MATH 4100: Differential Equations
(course-leveled with MATH 7100). Traditional introductory course in ordinary differential equations. Includes 1st and 2nd order linear differential equations with numerous applications; Laplace transforms; power series solutions; numerical methods, linear systems.
Credit Hours: 3
Prerequisites: MATH 2300 or MATH 2340. Writing intensive sections require ENGLSH 1000

MATH 4140: Matrix Theory
(course-leveled with MATH 7140). Basic properties of matrices, determinants, vector spaces, linear transformations, eigenvalues, eigenvectors, and Jordan normal forms. Introduction to writing proofs.
Credit Hours: 3
Prerequisites: MATH 2300 or MATH 2320. Writing intensive sections require ENGLSH 1000

MATH 4140W: Matrix Theory - Writing Intensive
Basic properties of matrices, determinants, vector spaces, linear transformations, eigenvalues, eigenvectors, and Jordan normal forms. Introduction to writing proofs.
Credit Hours: 3
Prerequisites: Grade of C- or above in MATH 2300

MATH 4150: History of Mathematics
This is a history course with mathematics as its subject. Includes topics in the history of mathematics from early civilizations onwards. The growth of mathematics, both as an abstract discipline and as a subject which interacts with others and with practical concerns, is explored.
Prerequisites or Corequisite: MATH 2300 or MATH 2340. Writing intensive sections require ENGLSH 1000.
Credit Hours: 3

MATH 4300: Numerical Analysis
Machine arithmetic, approximation and interpolation, numerical differentiation and integration, nonlinear equations, linear systems, differential equations, error analysis. Selected algorithms will be programmed for solution on computers.
Credit Hours: 3
Prerequisites: Grade of C- or better in MATH 2300 and MATH 4100

MATH 4310: Numerical Linear Algebra
Solution of linear systems of equations by direct and iterative methods. Calculation of eigenvalues and eigenvectors of matrices. Selected algorithms programmed for solution on computers.
Credit Hours: 3
Prerequisites: MATH 2300 and familiarity with software such as Mathematica, MatLab, Maple, etc

MATH 4315: Introduction to Mathematical Statistics
(same as STAT 4710). Introduction to theory of probability and statistics using concepts and methods of calculus.
Credit Hours: 3
Prerequisites: MATH 2300 or instructor's consent

MATH 4320: Introduction to Probability Theory
(same as STAT 4750). Probability spaces; random variables and their distributions; repeated trials; probability limit theorems.
Credit Hours: 3
Prerequisites: MATH 2300 or instructor's consent

MATH 4330: Theory of Numbers
Divisibility, factorization, arithmetic functions, means value theorems, distribution of prime numbers, congruences, primitive roots, character theory, Riemann zeta function, and Dirichlet L-functions.
Credit Hours: 3
Prerequisites: Grade of C- or higher in MATH 2300. Recommended MATH 2320

MATH 4350: Introduction to Non-Euclidean Geometry
Credit Hours: 3
Prerequisites: MATH 2300

MATH 4355: Mathematics of Financial Derivatives I
(course-leveled with MATH 7355). Long and short positions, forward contracts, exchange traded index futures, European and American
call and put options, put-call parity, trading and hedging strategies, synthetic transactions, arbitrage, currency options, fixed income portfolio management, duration, convexity, interest rate and currency swaps, embedded options.

**Credit Hours:** 3  
**Prerequisites:** Grade of C- or higher in MATH 2300 and either STAT 2500 or STAT 4710 or MATH 4315

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**MATH 4370: Interest Theory**  
(cross-leveled with MATH 7370). This course covers the concepts underlying the theory of interest and their applications to valuation of various cash flows, annuities certain, bonds, and loan repayment. This course is designed to help students prepare for Society of Actuaries exam FM (Financial Mathematics). It is oriented towards problem solving techniques applied to real-life situations and illustrated with previous exam problems.

**Credit Hours:** 3  
**Prerequisites:** grade of C-or better in MATH 2300

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**MATH 4371: Models for Life Contingencies I**  
(cross-leveled with MATH 7371). The sequence MATH 4371 - MATH 4372 is designed to help students prepare for the Society of Actuaries exam LTAM (Long-Term Actuarial Mathematics). This course teaches the basic theory of life contingent actuarial models and the applications of those models to insurance and other financial risks. Covered topics include: survival models, life tables and selection, insurance benefits, life annuities, premium calculation and reserves.

**Credit Hours:** 3  
**Prerequisites:** MATH 4320 or STAT 4750, and MATH 4370

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**MATH 4372: Models for Life Contingencies II**  
(cross-leveled with MATH 7372). The sequence MATH 4371 - MATH 4372 is designed to help students prepare for the Society of Actuaries exam LTAM (Long-Term Actuarial Mathematics). This course extends the life-death contingency models of Math 4371 to more general multiple-state and multiple-life models applied to problems involving a wide range of insurance and pension benefits. Covered topics include: Markov chains, multiple decrement models, joint life and last survivor benefits, pension mathematics, profit testing.

**Credit Hours:** 3  
**Prerequisites:** A grade of C- or better in MATH 4371

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**MATH 4400: Introduction to Topology**  
Topics from topology of Euclidean spaces, generalizations to metric spaces and topological spaces. Fundamentals of point set topology.

**Credit Hours:** 3  
**Prerequisites:** MATH 2300

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**MATH 4500: Applied Analysis**  
Solution of the standard partial differential equations (wave, heat, Laplace's eq.) by separation of variables and transform methods; including eigenfunction expansions, Fourier and Laplace transform. Boundary value problems, Sturm-Liouville theory, orthogonality, Fourier, Bessel, and Legendre series, spherical harmonics.

**Credit Hours:** 3  
**Prerequisites:** Grade of C- or higher in MATH 4100

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**MATH 4510: Higher Algebra**  
Introduction to rings, integral domains, fields, groups.

**Credit Hours:** 3  
**Prerequisites:** Grade of C- or higher in MATH 2300 or MATH 2320

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**MATH 4520: Statistical Inference I**  
(same as STAT 4760). Sampling; point estimation; sampling distribution; tests of hypotheses; regression and linear hypotheses.

**Credit Hours:** 3  
**Prerequisites:** MATH 4320

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**MATH 4540: Mathematical Modeling I**  
Solution of problems from industry, physical, social and life sciences, economics, and engineering using mathematical models.

**Credit Hours:** 3  
**Prerequisites:** Grade of C- or higher in MATH 2300 and MATH 4100  
**Recommended:** Familiarity with software such as MATHEMATICA, MATLAB, or MAPLE

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**MATH 4560: Nonlinear Dynamics, Fractals and Chaos**  
Conceptual introduction to nonlinear dynamics, bifurcation and stability of steady states, chaos in nonlinear differential equations and maps, fractal dimension, strange attractors, and applications to physical science.

**Credit Hours:** 3  
**Prerequisites:** MATH 4100 or MATH 7100, MATH 4140 or MATH 7140, and familiarity with software such as MATHEMATICA, MATLAB, or MAPLE

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**MATH 4590: Mathematics of Financial Derivatives II**  

**Credit Hours:** 3  
**Prerequisites:** MATH 2300 and either STAT 2500 or STAT 4710 or MATH 4315  
**Recommended:** MATH 4355

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**MATH 4700: Advanced Calculus of One Real Variable I**  
(cross-leveled with MATH 7700). Basic topology of the real line, numerical sequences and series, continuity, differentiability, Riemann integration, uniform convergence, power series.

**Credit Hours:** 3  
**Prerequisites:** Grade of C - or higher in MATH 3000

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**MATH 4720: Introduction to Abstract Algebra I**  
Basic properties of integers, fundamental theorem of arithmetic, introduction to groups, rings and fields.

**Credit Hours:** 3  
**Prerequisites:** Grade of C- or higher in MATH 3000
MATH 4900: Advanced Multivariable Calculus
(cross-leveled with MATH 7900). This is a course in calculus in several variables. The following is core material: Basic topology of n-dimensional Euclidian space; limits and continuity of functions; the derivative as a linear transformation; Taylor's formula with remainder; the Inverse and Implicit Function Theorems, change of coordinates; integration (including transformation of integrals under changes of coordinates); Green's Theorem. Additional material from the calculus of several variables may be included, such as Lagrange multipliers, differential forms, etc.

Credit Hours: 3
Prerequisites: MATH 4700

MATH 4920: Introduction to Abstract Linear Algebra
(cross-leveled with MATH 7920). Study of vector spaces over arbitrary fields: topics include linear maps on finite dimensional vector spaces, bilinear and multi-linear forms, invariant subspaces and canonical forms.

Credit Hours: 3
Prerequisites: Grade of C- or higher in MATH 4720

MATH 4940: Introduction to Complex Variables
Complex functions, contour integration, power series, residues and poles, conformal mapping.

Credit Hours: 3
Prerequisites: MATH 4110 or MATH 4700

MATH 4960: Special Readings in Mathematics
Credit Hour: 1-3
Prerequisites: Consent of Department required

MATH 4996: Honors in Mathematics
Special work for senior B.A. Honors and B.S. Honors candidates.

Credit Hours: 2
Prerequisites: Consent of Department required

MATH 7100: Differential Equations
(cross-leveled with MATH 4100). Traditional introductory course in ordinary differential equations. Includes 1st and 2nd order linear differential equations with numerous applications; Laplace transforms; power series solutions; numerical methods, linear systems.

Credit Hours: 3
Prerequisites: graduate standing and MATH 2300

MATH 7140: Matrix Theory
(cross-leveled with MATH 4140). Basic properties of matrices, determinants, vector spaces, linear transformations, eigenvalues, eigenvectors, and Jordan normal forms. Introduction to writing proofs.

Credit Hours: 3
Prerequisites: graduate standing and one of MATH 2300, MATH 2320, MATH 2120 or MATH 2340

MATH 7150: History of Mathematics
This is a history course with mathematics as its subject. Includes topics in the history of mathematics from early civilizations onwards. The growth of mathematics, both as an abstract discipline and as a subject which interacts with others and with practical concerns, is explored. Pre- or Co-require: MATH 2300 or MATH 2340 and graduate standing.

Credit Hours: 3

MATH 7300: Numerical Analysis
Machine arithmetic, approximation and interpolation, numerical differentiation and integration, nonlinear equations, linear systems, differential equations, error analysis. Selected algorithms will be programmed for solution on computers.

Credit Hours: 3
Prerequisites: MATH 2300 and MATH 2300 or MATH 4100 or equivalent

MATH 7310: Numerical Linear Algebra
Solution of linear systems of equations by direct and iterative methods. Calculation of eigenvalues and eigenvectors of matrices. Selected algorithms programmed for solution on computers.

Credit Hours: 3
Prerequisites: MATH 2300 and prior experience writing programs in Mathematica and/or in a computer language such as Fortran, Pascal, or C
Recommended: MATH 4140

MATH 7330: Theory of Numbers
Divisibility, factorization, arithmetic functions, means value theorems, distribution of prime numbers, congruences, primitive roots, character theory, Riemann zeta function, and Dirichlet L-functions.

Credit Hours: 3
Prerequisites: MATH 2300; recommended MATH 2320 or MATH 2340, and MATH 4940 or MATH 7940

MATH 7355: Mathematics of Financial Derivatives I
(cross-leveled with MATH 4355). Long and short positions, forward contracts, exchange traded index futures, European and American call and put options, put-call parity, trading and hedging strategies, synthetic transactions, arbitrage, currency options, fixed income portfolio management, duration, convexity, interest rate and currency swaps, embedded options.

Credit Hours: 3
Prerequisites: MATH 2300 and STAT 2500 or STAT 4710/ MATH 4315, or instructor's consent

MATH 7370: Interest Theory
(cross-leveled with MATH 4370). This course covers the main probability tools applied to financial risk modeling, and the financial mathematics concepts used in calculating present and accumulated values for various cash flows. It is a helpful tool in preparing for the Society of Actuaries exams P (Probability) and FM (Financial Mathematics), and it is oriented towards problem solving techniques illustrated with previous exam problems. Students are encouraged to take MATH 4355 prior to this course.

Credit Hours: 3
Prerequisites: MATH 2300, MATH 4320/ STAT 4750
MATH 7371: Models for Life Contingencies I
(cross-leveled with MATH 4371). This sequence is designed to help students prepare for the Society of Actuaries exam LTAM (Long-Term Actuarial Mathematics). This course teaches the basic theory of life-contingent actuarial models and the applications of those models to insurance and other financial risks. Covered topics include: survival models, life tables and selection, insurance benefits, life annuities, premium calculation and reserves.

Credit Hours: 3
Prerequisites: A grade of C- or better in MATH 4371 or MATH 7371

MATH 7372: Models for Life Contingencies II
(cross-leveled with MATH 4372). This sequence is designed to help students prepare for the Society of Actuaries exam LTAM (Long-Term Actuarial Mathematics). This course extends the life-death contingency models of MATH 4371 to more general multiple-state and multiple-life models applied to problems involving a wide range of insurance and pension benefits. Covered topics include: Markov chains, multiple decrement models, joint life and last survivor benefits, pension mathematics, profit testing.

Credit Hours: 3
Prerequisites: A grade of C- or better in MATH 4371 or MATH 7371

MATH 7400: Introduction to Topology
Topics from topology of Euclidean spaces, generalizations to metric spaces and topological spaces. Fundamentals of point set topology.

Credit Hours: 3
Prerequisites: MATH 2300

MATH 7500: Advanced Multivariable Calculus
Introduction to rings, integral domains, fields, groups.

Credit Hours: 3
Prerequisites: MATH 2300 OR MATH 2320

MATH 7510: Higher Algebra
Introduction to rings, integral domains, fields, groups.

Credit Hours: 3
Prerequisites: MATH 2300 OR MATH 2320

MATH 7540: Mathematical Modeling I
Solution of problems from industry, physical, social and life sciences, economics, and engineering using mathematical models.

Credit Hours: 3
Prerequisites: MATH 4100/ MATH 7100

MATH 7560: Nonlinear Dynamics, Chaos and Fractals
Conceptual introduction to nonlinear dynamics, bifurcation and stability of steady states, chaos in nonlinear differential equations and maps, fractal dimension, strange attractors, and applications to physical science.

Credit Hours: 3

MATH 7570: Mathematics of Financial Derivatives II
(cross-leveled with MATH 4590). Binomial and Black-Scholes pricing models. Option Greeks, delta and gamma hedging, market maker profit theory. Asian, barrier, compound, gap and exchange options. Lognormal and Monte Carlo price simulation. Geometric Brownian Motion and Itô's Lemma. Interest rate models and volatility. Prerequisites: MATH 2300 and either STAT 2500 or STAT 4710 or MATH 4315.

Credit Hours: 3
Prerequisites: MATH 2300 and either STAT 2500 or STAT 4710 or MATH 4315

Recommended: MATH 4355

MATH 7700: Advanced Calculus of One Real Variable I
Basic properties of integers, fundamental theorem of arithmetic, introduction to groups, rings and fields.

Credit Hours: 3
Prerequisites: MATH 2300

Recommended: MATH 4140 and one other mathematics course number above MATH 2300

MATH 7720: Introduction to Abstract Algebra I
Basic properties of integers, fundamental theorem of arithmetic, introduction to groups, rings and fields.

Credit Hours: 3
Prerequisites: MATH 2300

Recommended: MATH 4140 and one other mathematics course number above MATH 2300

MATH 7900: Advanced Multivariable Calculus
Solution of the standard partial differential equations (wave, heat, Laplace's eq.) by separation of variables and transform methods; including eigenfunction expansions, Fourier and Laplace transform. Boundary value problems, Sturm-Liouville theory, orthogonality, Fourier, Bessel, and Legendre series, spherical harmonics.

Credit Hours: 3
Prerequisites: MATH 4100/ MATH 7100

MATH 7920: Introduction to Abstract Linear Algebra
Introduction to rings, integral domains, fields, groups.

Credit Hours: 3
Prerequisites: MATH 4700/ MATH 7700

MATH 7940: Introduction to Complex Variables
Solution of problems from industry, physical, social and life sciences, economics, and engineering using mathematical models.

Credit Hours: 3
Prerequisites: MATH 4100/ MATH 7100, MATH 4140/ MATH 7140, and familiarity with software such as MATHEMATICA, MATLAB, or MAPLE

MATH 7950: Mathematics of Financial Derivatives II
(cross-leveled with MATH 4590). Binomial and Black-Scholes pricing models. Option Greeks, delta and gamma hedging, market maker profit theory. Asian, barrier, compound, gap and exchange options. Lognormal and Monte Carlo price simulation. Geometric Brownian Motion and Itô's Lemma. Interest rate models and volatility. Prerequisites: MATH 2300 and either STAT 2500 or STAT 4710 or MATH 4315.

Credit Hours: 3
Prerequisites: MATH 2300 and either STAT 2500 or STAT 4710 or MATH 4315

Recommended: MATH 4355

MATH 7970: Mathematics of Financial Derivatives II
(cross-leveled with MATH 4590). Binomial and Black-Scholes pricing models. Option Greeks, delta and gamma hedging, market maker profit theory. Asian, barrier, compound, gap and exchange options. Lognormal and Monte Carlo price simulation. Geometric Brownian Motion and Itô's Lemma. Interest rate models and volatility. Prerequisites: MATH 2300 and either STAT 2500 or STAT 4710 or MATH 4315.

Credit Hours: 3
Prerequisites: MATH 2300 and either STAT 2500 or STAT 4710 or MATH 4315

Recommended: MATH 4355

MATH 7990: Advanced Multivariable Calculus
Solution of the standard partial differential equations (wave, heat, Laplace's eq.) by separation of variables and transform methods; including eigenfunction expansions, Fourier and Laplace transform. Boundary value problems, Sturm-Liouville theory, orthogonality, Fourier, Bessel, and Legendre series, spherical harmonics.

Credit Hours: 3
Prerequisites: MATH 4100/ MATH 7100

MATH 7940: Introduction to Complex Variables
Complex functions, contour integration, power series, residues and poles, conformal mapping.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Prerequisites</th>
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<tr>
<td>MATH 4110/ MATH 7110 OR MATH 4700/ MATH 7700</td>
<td>Mathematics (MATH)</td>
<td>3</td>
<td>MATH 4110/ MATH 7110 OR MATH 4700/ MATH 7700</td>
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<tr>
<td>MATH 7960: Special Readings in Mathematics</td>
<td>Credit Hour: 1-3</td>
<td></td>
<td>Prerequisites: MATH 2300 and instructor's consent</td>
</tr>
<tr>
<td>MATH 7980: Mathematics Problem Solving</td>
<td>Credit Hours: 3</td>
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<td>Prerequisites: MATH 4140 and another 4000 level Mathematics course, or instructor's consent</td>
</tr>
<tr>
<td>MATH 8085: Problems in Mathematics</td>
<td>Credit Hours: 3</td>
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<tr>
<td>MATH 8090: Master's Thesis Research in Mathematics</td>
<td>Students will be required to complete an independent project. Topics are chosen in consultation with a faculty advisor and are subject to departmental consent. Graded on S/U basis only.</td>
<td>3</td>
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<tr>
<td>MATH 8102: Topics in Algebra</td>
<td>Credit Hours: 3</td>
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<td>Prerequisites: MATH 8410</td>
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<td>MATH 8190: Masters Project in Mathematics</td>
<td>Masters Project in Mathematics</td>
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<td>MATH 8202: Topics in Functional Analysis</td>
<td>Topics in Functional Analysis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MATH 8210: Basic Algebra</td>
<td>Accelerated problem solving course in linear and abstract algebra. Will prepare students for the algebra qualifying exam.</td>
<td>3</td>
<td>Prerequisites: MATH 4720, MATH 4920, or instructor's consent, or equivalent Corequisites: MATH 8220 and MATH 8250</td>
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<tr>
<td>MATH 8220: Basic Analysis</td>
<td>Accelerated problem-solving course in advanced calculus and complex analysis. Will prepare students for the analysis qualifying exam.</td>
<td>6</td>
<td>Prerequisites: MATH 4700, MATH 4900, MATH 4940, instructor's consent or equivalent</td>
</tr>
<tr>
<td>MATH 8250: Basic Topology and Geometry</td>
<td>Topological spaces, differential manifolds, differential forms, integration of vector fields.</td>
<td>3</td>
<td>Prerequisites: MATH 4700, MATH 4900, MATH 4140, or instructor's consent, or equivalent Corequisites: MATH 8210 and MATH 8220</td>
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<tr>
<td>MATH 8302: Topics in Harmonic Analysis</td>
<td>Topics in Harmonic Analysis</td>
<td>3</td>
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<tr>
<td>MATH 8402: Topics in Mathematical Physics</td>
<td>Topics in Mathematical Physics</td>
<td>3</td>
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<tr>
<td>MATH 8410: Algebra I</td>
<td>Theory of algebraic structures--groups, rings, fields, algebraic and transcendental extensions of fields.</td>
<td>3</td>
<td>Prerequisites: MATH 4720 and MATH 4920, or equivalent</td>
</tr>
<tr>
<td>MATH 8411: Algebra II</td>
<td>Theory of modules, Galois theory and additional topics to be selected by the instructor.</td>
<td>3</td>
<td>Prerequisites: MATH 8410 or equivalent</td>
</tr>
<tr>
<td>MATH 8420: Theory of Functions of Real Variables I</td>
<td>Properties of functions of one real variable. Lebesgue measure and integration on the line.</td>
<td>3</td>
<td>Prerequisites: MATH 4700 or MATH 7700 and MATH 4900 or MATH 7900, or equivalent</td>
</tr>
<tr>
<td>MATH 8421: Theory of Functions of Real Variables II</td>
<td>Continuation of MATH 8420. General measure and integration theory. Elements of the theory of Hilbert and Banach spaces, linear functions and linear operators.</td>
<td>3</td>
<td>Prerequisites: MATH 8420</td>
</tr>
<tr>
<td>MATH 8425: Complex Analysis I</td>
<td>Rigorous introduction to the theory of functions of a complex variable.</td>
<td>3</td>
<td>Prerequisites: MATH 4940 or MATH 7940 or equivalent</td>
</tr>
<tr>
<td>MATH 8426: Complex Analysis II</td>
<td>Analytic continuation, Riemann surfaces, entire and meromorphic functions, selected topics.</td>
<td>3</td>
<td>Prerequisites: MATH 8425</td>
</tr>
</tbody>
</table>
MATH 8440: Advanced Ordinary Differential Equations I
Topics from existence and uniqueness theorems, plane autonomous systems, periodicity and boundedness of solutions of second order nonlinear equations, perturbation theory, Sturm-Liouville systems, behavior of solutions at singularities.
Credit Hours: 3
Prerequisites: MATH 4700 or MATH 7700 or equivalent

MATH 8445: Partial Differential Equations I
Fourier and integral transforms, first and second order partial differential equations, methods of characteristics, Laplace's equation, Dirichlet and Neumann problems, Green's functions and maximum principles.
Credit Hours: 3
Prerequisites: MATH 4700 or MATH 7700 or instructor's consent required

MATH 8446: Partial Differential Equations II
The Cauchy-Kovalevski theorem, the Lewy example, the heat operator, the wave operator, Sobolev spaces, local regularity of elliptic boundary value problems.
Credit Hours: 3
Prerequisites: MATH 4700 or MATH 7700 or instructor's consent required

MATH 8460: Mathematical Finance I
Credit Hours: 3
Prerequisites: graduate standing in Mathematics. Knowledge of elementary probability or instructor's consent

MATH 8461: Mathematical Finance II
Credit Hours: 3
Prerequisites: knowledge of advance probability/stochastic processes or instructor's consent
Recommended: MATH 8460

MATH 8480: Advanced Probability
(same as STAT 9810). Measure theoretic probability theory. Characteristic functions; conditional probability and expectation; sums of independent random variables including strong law of large numbers and central limit problem.
Credit Hours: 3
Prerequisites: MATH 4320 or MATH 8220; or instructor's consent

MATH 8502: Topics of Geometry
Topics of Geometry.
Credit Hours: 3
Prerequisites: instructor's consent

MATH 8587: Topology Seminar
Topology Seminar
Credit Hours: 3

MATH 8615: Algebraic Geometry I
Affine and projective varieties and schemes; nullstellensatz; Zariski topology, morphisms and rational maps; divisors and linear systems; topics from curves, surfaces, Grassmann varieties; commutative algebra and homological algebra as needed.
Credit Hours: 3
Prerequisites: MATH 8410
Recommended: MATH 8460

MATH 8616: Algebraic Geometry II
Continuation of MATH 8615.
Credit Hours: 3
Prerequisites: MATH 8615

MATH 8618: Introduction to Algebraic Topology
Development of singular homology theory; reference to other homology and cohomology theories. Introduction to homological algebra.
Credit Hours: 3
Prerequisites: MATH 8250

MATH 8628: Functional Analysis I
Linear topological spaces, Banach spaces, Hilbert spaces. Operator theory, including the Hahn-Banach, uniform boundedness and closed graph theorems.
Credit Hours: 3
Prerequisites: MATH 4900 and instructor's consent or MATH 8420

MATH 8630: Harmonic Analysis I
An introduction to Fourier Analysis in one and higher Dimensions. Topics include Fourier Series, conjugate functions, Fourier transforms, distributions, interpolation, and maximal functions.
Credit Hours: 3
Prerequisites: MATH 8420

MATH 8650: Differentiable Manifolds and Riemannian Geometry
Tensor product spaces and tensor fields on manifolds. Differentiation and integration of differential forms. Riemannian geometry and applications.
Mathematics (MATH)

Credit Hours: 3
Prerequisites: MATH 4700 or MATH 4400

MATH 8655: General Topology I
Credit Hours: 3
Prerequisites: MATH 4900, MATH 4400 or instructor's consent

MATH 8702: Topics in Applied Mathematics
Selected topics in applied mathematics drawn from variety of areas: partial differential equations, tensor analysis, calculus of variations, asymptotic methods, integral equations, advanced theory of transforms and distributions, numerical analysis.
Credit Hours: 3

MATH 9090: Doctoral Dissertation Research in Mathematics
Doctoral Dissertation Research in Mathematics. Graded on a S/U basis only.
Credit Hour: 1-9

MATH 9387: Harmonic Analysis Seminar
Harmonic Analysis Seminar
Credit Hours: 3

MATH 9487: Mathematical Physics Seminar
Mathematical Physics Seminar
Credit Hours: 3

MATH 9502: Topics in Topology
Advanced topics in topology or topological algebra.
Credit Hours: 3

MATH 9787: Applied Mathematics Seminar
Applied Mathematics Seminar
Credit Hours: 3

MATH 9887: Analysis Seminar
Analysis Seminar
Credit Hours: 3