

## Mathematics (MATH)

### MATH 100R

#### Math Leap

1

Is part of UVU's math placement process; for students who desire to review math topics in order to improve placement level before beginning a math course. Addresses unique strengths and weaknesses of students, by providing group problem solving activities along with an individual assessment and study plan for mastering target material. Requires mandatory class attendance and a minimum number of hours per week logged into a preparation module, with progress monitored by a mentor. May be repeated for a maximum of 4 credits toward graduation. May be graded credit/no credit.

### MATH 1050

#### College Algebra

4

\* Prerequisite(s): Within the past two years one of the following: MAT 1010 or MAT 1015 with a grade of C or better or appropriate math placement score.

Includes inequalities, functions and their graphs, polynomial and rational functions, exponential and logarithmic functions, systems of linear and nonlinear equations, matrices and determinants, arithmetic and geometric sequences, and the Binomial Theorem. May be delivered hybrid and/or online.

### MATH 1055

#### College Algebra with Preliminaries

5

\* Prerequisite(s): Within the past two years one of the following: MAT 1010 or MAT 1015 with a grade of C or better or appropriate math placement score.

Includes inequalities, functions and their graphs, polynomial and rational functions, exponential and logarithmic functions, systems of linear and nonlinear equations, matrices and determinants, arithmetic and geometric sequences, and the Binomial Theorem. May be delivered hybrid and/or online.

### MATH 1060

#### Trigonometry

3

\* Prerequisite(s): Within the past two years: MATH 1050 or MATH 1055 with a grade of C or higher or appropriate math placement score.

Includes the unit circle and right triangle definitions of the trigonometric functions, graphing trigonometric functions, trigonometric identities, trigonometric equations, inverse trigonometric functions, the Law of Sines and the Law of Cosines, vectors, complex numbers, polar coordinates, and rotation of axes.

### MATH 1080

#### Precalculus

5

\* Prerequisite(s): Within the past two years, one of the following: MAT 1010 or MAT 1015 with a grade of B or better or an appropriate math placement score.

Is an accelerated version of MATH 1050 and MATH 1060. Includes functions and their graphs including polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions. Covers inequalities, systems of linear and nonlinear equations, matrices, determinants, arithmetic and geometric sequences, the Binomial Theorem, the unit circle, right triangle trigonometry, trigonometric equations, trigonometric identities, the Law of Sines, the Law of Cosines, vectors, complex numbers, polar coordinates, and conic sections.

### MATH 1090

#### College Algebra for Business

3

\* Prerequisite(s): Within the past two years one of the following: MAT 1010 or MAT 1015 with a grade of C or better or appropriate math placement score.

Uses linear, quadratic, power, polynomial, rational, exponential, logarithmic, and logistic functions to analyze business applications such as market equilibrium, rates of change, cost-benefit analysis, and inflation. Includes systems of linear and non-linear equations and inequalities, matrices and matrix equations, sequences and series, and financial mathematics. Canvas Course Mats \$90/McGraw applies.

### MATH 1100

#### Survey of Calculus

3

\* Prerequisite(s): Within the past two years: MATH 1050 or MATH 1055 or MATH 1080 with a grade of C or better or appropriate math placement score.

Provides a comprehensive survey of the basic concepts and techniques of differential and integral calculus. Covers topics from both single and multivariable calculus including limits, continuity, differentiation, partial differentiation, integration, single variable and multivariate optimization. Includes the derivatives and integrals of polynomial functions, rational functions, exponential functions, and logarithmic functions, and partial differentiation of multivariate versions of these same functions. Emphasizes applications to specific disciplines such as business, computer science, and the life sciences.

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### MATH 1210

#### Calculus I

4

\* Prerequisite(s): One of the following within the past two years: (MATH 1050 or MATH 1055) and MATH 1060, each with a grade of C or higher; OR MATH 1080 with a grade of C or higher; OR appropriate placement by math placement test.

Covers limits, continuity, differentiation, applications of differentiation, integration, and applications of integration, including derivatives and integrals of polynomial functions, rational functions, exponential functions, logarithmic functions, trigonometric functions, inverse trigonometric functions, and hyperbolic functions. Is a prerequisite for calculus-based sciences.

### MATH 121H

#### Calculus I

4

\* Prerequisite(s): One of the following within the past two years: (MATH 1050 or MATH 1055) and MATH 1060, each with a grade of C or higher; OR MATH 1080 with a grade of C or higher; OR appropriate placement by math placement test.

Covers limits, continuity, differentiation, applications of differentiation, integration, and applications of integration, including derivatives and integrals of polynomial functions, rational functions, exponential functions, logarithmic functions, trigonometric functions, inverse trigonometric functions, and hyperbolic functions. Is a prerequisite for calculus-based sciences. Is an honors course with student projects.

### MATH 1220

#### Calculus II

4

\* Prerequisite(s): MATH 1210 or MATH 121H with a grade of C or higher

Includes applications of integration, integration techniques, arc length, area of a surface of revolution, moments and centers of mass, sequences and series, and parametrization of curves and polar coordinates.

### MATH 122H

#### Calculus II

4

\* Prerequisite(s): MATH 1210 or MATH 121H with a grade of C or higher

Includes integration techniques, arc length, area of a surface of revolution, moments and centers of mass, sequences and series, parametrization of curves and polar coordinates. Honors course which requires a student project.

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# Course Descriptions

## **MATH 2000**

### **Algebraic Reasoning with Modeling QL**

**3**

\* Prerequisite(s): Within the past two years, one of the following: MAT 1010 or MAT 1015 with a grade of C or better or an appropriate math placement score.

Presents the basic ideas of sets and functions in the context of and motivated by modeling bivariate data. Includes basic set theory such as unions, intersections, Venn diagrams, etc. Includes the basic ideas and the algebra of functions including polynomial, exponential, and logarithmic functions. Also includes some basic combinatorics and counting principles as well as arithmetic and geometric sequences. Culminates in a pictorial introduction to the basic ideas of calculus presented with minimal computation.

## **MATH 2010**

### **Mathematics for Elementary Teachers I**

**3**

\* Prerequisite(s): Within the past two years: MATH 1050 or MATH 1055 or MATH 2000 with a grade of C or better or appropriate math placement score.

Is for pre-elementary education majors. Includes problem solving, sets, numeration systems, arithmetic of whole numbers, integers, rational numbers, real numbers, elementary number theory, ratios, proportions, decimals, and percents.

## **MATH 2020**

### **Mathematics for Elementary Teachers II**

**3**

\* Prerequisite(s): MATH 2010 with a grade of C or higher

Is for pre-elementary education majors. Includes topics on probability, statistics, geometry and measurement.

## **MATH 2210**

### **Calculus III**

**4**

\* Prerequisite(s): MATH 1220 or MATH 122H with a grade of C or higher

Includes vectors in 3-space, quadric surfaces, partial derivatives, gradient, Lagrange multipliers, multiple integrals, line integrals, Green's Theorem, surface integrals, the Divergence Theorem, and Stokes' Theorem.

## **MATH 221H**

### **Calculus III**

**4**

\* Prerequisite(s): MATH 1220 or MATH 122H with a grade of C or higher

Includes vectors in 3-space, quadric surfaces, partial derivatives, gradient vectors, Lagrange multipliers, multiple integrals, line integrals, Green's Theorem, surface integrals, the Divergence Theorem, and Stokes' Theorem. Is an honors course which includes a student project.

## **MATH 2250**

### **Differential Equations and Linear Algebra**

**4**

\* Prerequisite(s): MATH 1220 or MATH 122H with a grade of C or higher

Is for engineering students. Includes separable equations, linear differential equations, differential operators and annihilators, variation of parameters, Laplace transforms, and systems of linear differential equations. Introduces basic concepts of linear algebra including matrices, Gaussian elimination, determinants, linear independence, and eigenvalues and eigenvectors.

## **MATH 2270**

### **Linear Algebra**

**3**

\* Prerequisite(s): MATH 1210 or MATH 121H with a grade of C or higher

Includes matrices and systems of equations, determinants, vector spaces, linear transformations, orthogonality, and eigenvalues and eigenvectors.

## **MATH 2280**

### **Ordinary Differential Equations**

**3**

\* Prerequisite(s): MATH 2210 or MATH 221H with a grade of C or higher

Includes separable equations, linear differential equations, differential operators and annihilators, variation of parameters, power series solutions of differential equations, Laplace transforms, systems of linear differential equations, and numerical methods.

## **MATH 281R**

### **Cooperative Work Experience**

**2 to 9**

\* Prerequisite(s): Approval of Cooperative Coordinator

Designed for mathematics majors. Provides paid work experiences in the student's major. Course content is individualized, with the student setting the objectives by consulting with a faculty coordinator and the on-the-job supervisor. Credit is determined by the number of hours the student works during the semester. Repeatable for a maximum of 16 credits toward graduation. May be graded credit/no credit.

## **MATH 290R**

### **Topics in Mathematics**

**3 to 5**

\* Prerequisite(s): Departmental approval

Studies a chosen topic in mathematics; topic will vary depending upon student demand and course development needs. May be taken more than once for different topics and for a maximum of 6 credit hours counted toward graduation.

## **MATH 3000**

### **History of Mathematics WE**

**3**

\* Prerequisite(s): MATH 2210 or MATH 221H with a grade of C or higher and University Advanced Standing

Provides a survey of the history of mathematics with a focus on the development of mathematical ideas in their historical context. Includes numeration systems, the mathematics of the ancient world, the development of algebra, geometry, and calculus, and the work of pivotal mathematicians.

## **MATH 3010**

### **Methods of Secondary School Mathematics Teaching**

**3**

\* Prerequisite(s): MATH 2210 or MATH 221H with a grade of C or higher and EDSC 455G with a grade of B- or higher and University Advanced Standing

Is for Mathematics Education majors. Presents different methods of teaching mathematical ideas at the secondary school level. Includes classroom instruction, student presentations, and field experiences. Studies various techniques of assessment and classroom management.

## **MATH 3020**

### **Computer Based Mathematics for Secondary School Mathematics Teachers**

**3**

\* Prerequisite(s): (MATH 2210 and MATH 2270 each with a grade of C or higher) and University Advanced Standing; MATH 2280 with a grade of C or higher is recommended

For Mathematics Education majors. Presents one or more popular mathematical computer software packages. Includes mathematical problem solving and presentations of mathematical concepts using a computer as an aid. Introduces appropriate programming language.

### **MATH 3030**

#### **Algebra for Secondary Mathematics**

##### **Teaching**

**3**

\* Prerequisite(s): Math 1210 with a grade B- or higher and University Advanced Standing and Mathematics Department Adviser Approval

For Mathematics Education Majors: Includes the exploration of important conceptual underpinnings, common misconceptions and students' ways of thinking, appropriate use of technology, and instructional practices to support and assess the learning of algebra. Teaches algebra as an extension of number, operation, and quantity; various ideas of equivalence as it pertains to algebraic structures; patterns of change as covariation between quantities; connections between representations (tables, graphs, equations, geometric models, context); and the historical development of content and perspectives from diverse cultures. Focuses on deeper understanding of rational numbers, ratios and proportions, meaning and use of variables, functions (e.g., exponential, logarithmic, polynomials, rational, quadratic), and inverses.

### **MATH 3100**

#### **Foundations of Geometry**

**3**

\* Prerequisite(s): MATH 2270 with a grade of C or higher and MATH 2210 with a grade of C or higher and University Advanced Standing

\* Prerequisite(s) or Corequisite(s): MATH 2280

Introduces logic and mathematical proof. Offers an axiomatic development of Euclidean and non-Euclidean geometries.

### **MATH 3200**

#### **Foundations of Analysis**

**3**

\* Prerequisite(s): MATH 3100 with a grade of C or higher and MATH 2280 with a grade of C or higher and University Advanced Standing

Covers material from beginning analysis including the axioms of the real numbers, sequences, mathematical induction, limits, topology of the real line, continuity, differentiation, and integration.

### **MATH 3210**

#### **Complex Variables**

**3**

\* Prerequisite(s): MATH 2210 or MATH 221H with a grade of C or higher and University Advanced Standing

Introduces complex analysis. Includes algebra of complex numbers, analytic functions, mapping properties of elementary functions, the Cauchy integral formula, complex series, residues, and conformal mapping.

### **MATH 3250**

#### **Introduction to Advanced Calculus WE**

**3**

\* Prerequisite(s): (MATH 2210 or MATH 221H) with a grade of C or higher and MATH 2270 with a grade of C or higher and University Advanced Standing

\* Prerequisite(s) or Corequisite(s): MATH 2280

Introduces mathematical logic and proof. Covers the first topics of advanced calculus including the axioms of the real numbers, sequences, mathematical induction, limits, topology of the real numbers, continuity, differentiation, and integration.

### **MATH 3300**

#### **Foundations of Abstract Algebra**

**3**

\* Prerequisite(s): MATH 3100 or MATH 3250 with a grade of C or higher and University Advanced Standing

Provides an introduction to algebraic structures. Covers the theory of groups including modular arithmetic, normal subgroups, factor groups, and cyclic groups. Introduces rings, integral domains, and fields.

### **MATH 3310**

#### **Discrete Mathematics**

**3**

\* Prerequisite(s): MATH 1220 with a grade of C or higher and University Advanced Standing

Includes logic, sets, functions, elementary number theory, mathematical induction, equivalence relations, and cardinality. Emphasizes the writing of proofs.

### **MATH 3320**

#### **Graph Theory and its Applications**

**3**

\* Prerequisite(s): MATH 2270 with a grade of C or higher and University Advanced Standing

Introduces the most important topics of graph theory including graphs and modeling, trees, paths, circuits, and connectivity, matching, planar graphs and coloring, and applications.

### **MATH 3400**

#### **Partial Differential Equations**

**3**

\* Prerequisite(s): MATH 2280 with a grade of C or higher and University Advanced Standing

Introduction to partial differential equations. Topics include Bessel functions, Legendre polynomials, Fourier analysis, partial differential equations, and boundary value problems.

### **MATH 3640**

#### **Introduction to Optimization**

**3**

\* Prerequisite(s): (MATH 2210 or MATH 221H) and MATH 2270 with a grade of C or higher and University Advanced Standing; CS 1400 with a grade of C or higher is recommended.

Includes linear, quadratic, and nonlinear programming, network problems, convexity, necessary and sufficient optimality conditions, numerical algorithms, and special topics.

### **MATH 3750**

#### **Financial Mathematics**

**3**

\* Prerequisite(s): (MATH 1220 or FIN 3100 each with a grade of C or higher) and University Advanced Standing

Prepares students to take Exam FM/Exam 2 given by the Society of Actuaries/Casualty Actuarial Society. Trains students to answer complex questions under significant time pressure. Teaches the principles and mathematics of interest, annuities, amortization, investments, financial economics, derivative investment contracts and financial risk management.

### **MATH 4015**

#### **Actuarial Problems Laboratory**

**1**

\* Prerequisite(s): STAT 4710 and University Advanced Standing

Provides preparation for the probability actuarial examination (Exam P) by linking concepts of probability and mathematical statistics to actuarial applications.

### **MATH 4025**

#### **Actuarial Problems Finance Laboratory**

**1**

\* Prerequisite(s): (MATH 3750 or Departmental Approval) and University Advanced Standing

Provides preparation for the financial mathematics actuarial examination (Exam FM) by linking concepts of finance to actuarial applications.

### **MATH 4030**

#### **Geometry for Secondary Mathematics**

**Teaching**

**3**

\* Prerequisite(s): Math 3100 with a grade C or higher and University Advanced Standing

For Mathematics Education Majors. Includes the exploration of important conceptual underpinnings, common misconceptions and students' ways of thinking, appropriate use of technology, and instructional practices to support and assess the learning of geometry. Teaches constructions and transformations, congruence and similarity, analytic geometry, solid geometry, conics, trigonometry, and the historical development of content and perspectives from diverse cultures. Makes explicit connections to various mathematical content strands (modeling, complex numbers, function, and algebra).

## Course Descriptions

### **MATH 4040**

#### **Statistics and Probability for Secondary Mathematics Teaching**

**3**

\* Prerequisite(s): Math 1210 with a grade B- or higher and STAT 2040 with a grade C or higher and University Advanced Standing

For Mathematics Education Majors. Includes the exploration of important conceptual underpinnings, common misconceptions and students' ways of thinking, appropriate use of technology, and instructional practices to support and assess the learning of statistics and probability. Focuses on summarizing and representing data, study design and sampling, probability, testing claims and drawing conclusions, and the historical development of content and perspectives from diverse cultures.

### **MATH 4100**

#### **Differential Geometry of Curves and Surfaces**

**3**

\* Prerequisite(s): MATH 3250 with a grade of C or higher and University Advanced Standing

Presents the differential geometry of curves and surfaces. Includes parametrized curves, arc length, surfaces, tangent planes, area, curvature, the Gauss map, vector fields, isometries, geodesics, the Gauss-Bonnet theorem, and other curves and surfaces topics selected by the instructor.

### **MATH 4210**

#### **Advanced Calculus I**

**3**

\* Prerequisite(s): MATH 3250 with a grade of C or higher and MATH 2280 with a grade of C or higher and University Advanced Standing

Covers limit and differentiation theorems, L'Hopital's rule, integration, the Fundamental Theorem of Calculus, series convergence, Taylor series, compactness, and an introduction to the geometry and topology of Euclidean spaces.

### **MATH 4220**

#### **Advanced Calculus II**

**3**

\* Prerequisite(s): MATH 4210 with a grade of C or higher, and University Advanced Standing

Covers the topology of Euclidean spaces, vectors and linear transformations, multivariable limits and continuity, multivariable differentiation, Jordan regions, multivariable Riemann integration, and Taylor series in multiple variables.

### **MATH 4250**

#### **Introduction to Dynamical Systems**

**3**

\* Prerequisite(s): MATH 3250 with a grade of C or better, and University Advanced Standing.

Provides a foundation in dynamical systems. Discusses fundamental topics of dynamics, including graphical analysis, orbits, periodic and fixed points, convergence, bifurcations, symbolic dynamics, chaos, and Sarkovskii's Theorem. May include fractals, complex functions, and fractal dimension.

### **MATH 4310**

#### **Introduction to Modern Algebra I**

**3**

\* Prerequisite(s): MATH 3300 with a grade of C or higher and University Advanced Standing

Provides a deeper treatment of topics in modern algebra. Covers direct products of groups and the classification of finite Abelian groups. Covers the theory of rings including ideals, factor rings, various kinds of integral domains, fields, and polynomial rings.

### **MATH 4320**

#### **Introduction to Modern Algebra II**

**3**

\* Prerequisite(s): MATH 4310 with a grade of C or higher and University Advanced Standing

Provides a deeper treatment of topics in the theory of groups, rings, and fields. Covers field extensions, algebraic extensions, finite fields, and Kronecker's Theorem. Includes applications to straightedge and compass geometric constructions. Covers other topics at the instructor's discretion which may include the Sylow Theorems, symmetry groups, and Galois Theory.

### **MATH 4330**

#### **Theory of Linear Algebra**

**3**

\* Prerequisite(s): MATH 3250 with a grade of C or higher and University Advanced Standing

Covers vector spaces, linear transformations and matrices, dual spaces, inner product spaces, orthogonality, bilinear forms, eigenvalues, eigenvectors and generalized eigenvectors, diagonalization, and Jordan and other canonical forms.

### **MATH 4340**

#### **Introduction to Number Theory**

**3**

\* Prerequisite(s): MATH 3250 with a grade of C or higher and University Advanced Standing

Covers divisibility, irreducibility and primality, linear Diophantine equations, Pell's equation, continued fractions, congruences, Euler's theorem, arithmetic functions, primitive roots, quadratic reciprocity.

### **MATH 4510**

#### **Foundations of Topology**

**3**

\* Prerequisite(s): MATH 3250 with a grade of C or higher and University Advanced Standing

Introduces the ideas of topologies, compactness, connectedness, countability, separability, separation axioms, homeomorphisms, and the Baire Category Theorem.

### **MATH 4610**

#### **Introduction to Numerical Analysis I**

**3**

\* Prerequisite(s): MATH 2270, MATH 2280, and CS 1400, each with a grade of C or higher, and University Advanced Standing

Includes numerical solutions of equations in one variable, numerical solutions of linear and nonlinear system of equations, interpolations and polynomial approximation, and approximating eigenvalues and eigenvectors.

### **MATH 4620**

#### **Introduction to Numerical Analysis II**

**3**

\* Prerequisite(s): MATH 4610 with a grade of C or higher and University Advanced Standing

Introduction to numerical analysis II. Topics will include numerical differentiation and integration, numerical solutions of initial-value problems and boundary-value problems for ordinary differential equations, numerical.

### **MATH 4750**

#### **Life Contingencies**

**3**

\* Prerequisite(s): STAT 4710 with a grade of C or higher and University Advanced Standing

Includes survival models, Markov Chains, life insurance and annuities, and Poisson processes. Prepares students for the life contingencies portion of Exam M of the Society of Actuaries.

### **MATH 481R**

#### **Internship in Mathematics**

**1 to 4**

\* Prerequisite(s): Instructor Approval and University Advanced Standing

For mathematics majors. Provides mathematics-related work experience in an industrial, commercial, or research environment. Internship credit may not be used in fulfilling the mathematics major course requirements. May be taken two times for a maximum of 6 credits toward graduation. May be graded credit/no credit.

## **MATH 489R** **Undergraduate Research in Mathematics** **1 to 3**

\* Prerequisite(s): MATH 3250 with a grade of C or better, Departmental Approval, and University Advanced Standing

Allows research on a project determined by a faculty member and approved by the department chair. Emphasizes proof, modeling, or other activities associated with mathematical research. May be used as part of a senior project. May be Graded Credit/No Credit. May be repeated for a maximum of 3 credits toward graduation.

## **MATH 490R** **Topics in Mathematics** **2 to 3**

\* Prerequisite(s): Departmental approval and University Advanced Standing

Studies a chosen topic in mathematics. The topic will vary depending upon student demand. Course may be taken more than once for different topics and for a maximum of 6 credit hours counted toward graduation.

## **MATH 4999** **Mathematics Capstone WE** **2**

\* Prerequisite(s): Instructor approval, departmental approval, and University Advanced Standing

Is for mathematics majors and is to be taken during the last semester before graduation. Reviews topics learned in the core undergraduate mathematics courses. Assesses student understanding through the Major Field Test. Provides an opportunity for senior mathematics majors to participate in mathematical research under the supervision of a faculty member. Offers a setting in which students prepare a research paper and give oral presentations that describe their research.

## **MATH 5510** **General Topology** **3**

\* Prerequisite(s): MATH 4510 or MATH 4210 with a grade of C or higher

Introduces the fundamentals of general topology, including topological spaces, separation axioms, continuity, compactness, connectedness, metric spaces, product spaces, metrization and ordinals.

## **MATH 6000** **Mathematics Core Review** **3**

\* Prerequisite(s): Department Approval

Reviews essential undergraduate mathematics for students seeking admission to the MS-Mathematics Education program. Reviews Calculus, Linear Algebra, Differential Equations, Geometry, Advanced Calculus, and Modern Algebra. May be graded credit/no credit.

## **MATH 6100** **Topics in Geometry and Topology** **3**

\* Prerequisite(s): Matriculation into the Mathematics Education, M.S. program or Matriculation into the Mathematics Graduate Certificate program, or approval of graduate program director.

Includes manifolds, fundamental group, classification of surfaces, covering spaces, homotopy types, differential geometry, Riemannian geometry, algebraic geometry, projective geometry, and algebraic topology.

## **MATH 6210** **Real Analysis** **3**

\* Prerequisite(s): Matriculation into the Mathematics Education, M.S. program or Matriculation into the Mathematics Graduate Certificate program, or approval of graduate program director.

Introduces students to fundamental analytic tools used across all of mathematics. Presents a proof based approach to analysis in Euclidean space and analysis in the general setting of metric spaces. Includes sequences, series, limits in  $\mathbb{R}^n$ , metric spaces, topology, differentiation, and integration.

## **MATH 6310** **Modern Algebra** **3**

\* Prerequisite(s): Matriculation into the Mathematics Education, M.S. program or Matriculation into the Mathematics Graduate Certificate program, or approval of graduate program director.

Covers advanced topics from group, ring, and field theory.

## **MATH 6330** **Advanced Linear Algebra** **3**

\* Prerequisite(s): Matriculation into the Mathematics Education, M.S. program or Matriculation into the Mathematics Graduate Certificate program, or approval of graduate program director.

Presents a proof and computation based approach to the theory of vector spaces, including bases, dimension, linear transformations, rank-nullity theorem, dual spaces, inner products, and canonical forms.

## **MATH 6350** **Introduction to Combinatorics** **3**

\* Prerequisite(s): Mathematics Endorsement 4, or instructor approval

Enumerates permutations and combinations of sets and multi-sets, inclusion-exclusion, recurrence relations, generating functions, Polya theory, and combinatorial structures.

## **MATH 6410** **Topics in Ordinary Differential Equations** **3**

\* Prerequisite(s): Matriculation into the Mathematics Education, M.S. program or Matriculation into the Mathematics Graduate Certificate program, or approval of graduate program director.

Includes the theory of linear and nonlinear ordinary differential equations and dynamical systems; the initial-value problems and behavior of solutions; the existence, uniqueness, perturbations, continuous dependence of solution on initial conditions, and introduction of nonlinear dynamical systems with applications.

## **MATH 6610** **Numerical Methods and Modeling** **3**

\* Prerequisite(s): Matriculation into the Mathematics Education, M.S. program or Matriculation into the Mathematics Graduate Certificate program, or approval of graduate program director.

Investigates modelling and numerical topics. Investigates topics from college algebra, calculus, linear algebra, and differential equations from a theoretical as well as numerical perspective. Expounds on algorithms and modelling through software packages in a hands-on approach.

## **MATH 6620** **Topics in Numerical Analysis** **3**

\* Prerequisite(s): Matriculation into the Mathematics Education, M.S. program or Matriculation into the Mathematics Graduate Certificate program, or approval of graduate program director.

Develops a deeper practical and theoretical understanding of methods used to find approximate solutions to a variety of mathematical problems and of the relationships between these algorithms. Compares accuracy, efficiency, and stability of methods used to solve nonlinear equations and large systems of linear and nonlinear algebraic equations; ordinary and partial differential equations; and to perform numerical differentiation, integration, interpolation and more general approximation of functions. Provides experience programming and applying many of the central algorithms that have powered modern advances in math and the sciences.

## **MATH 6700** **Applications of Mathematics** **3**

\* Prerequisite(s): Matriculation into the Mathematics Education, M.S. program or Matriculation into the Mathematics Graduate Certificate program, or approval of graduate program director.

Introduces various areas of mathematics that can be applied to other fields such as the sciences, arts, industry, etc. Includes topics such as game theory, graph theory, knot theory, number theory, etc.