

# MATHEMATICS (MATH)

## **MATH 403G Geometry for Elementary and Middle School Teachers 3 Hours**

Both formal and informal methods are used to explain the basic concepts of Euclidean geometry. Emphasis is given to the investigative approach, organizational skills, and problem solving.

**Restriction(s):** Students cannot enroll who are in Secondary Ed Teacher Leader (0435) or Mathematics (085)

*Recent Term(s) Offered: None*

## **MATH 405G Numerical Analysis I 3 Hours**

Computer arithmetic, roots of equations, polynomial approximation and interpolation, numerical differentiation and integration. Computer solutions of problems will be required.

**Prerequisite(s):** (MATH 307 or MATH 310 or MATH 237) and (CS 180 or CS 146) or permission of instructor

**Equivalent(s):** CS 405G

*Recent Term(s) Offered: fall 2019; fall 2020; fall 2021*

## **MATH 406G Numerical Analysis II 3 Hours**

The solution of linear systems by direct and iterative methods, matrix inversion, the calculation of eigenvalues and eigenvectors of matrices. Initial and boundary value problems in ordinary differential equations. Computer solution of problems will be required.

*Recent Term(s) Offered: spring 2019; spring 2020; spring 2021*

## **MATH 409G History of Mathematics 3 Hours**

History of mathematics from ancient times through the development of calculus with emphasis on famous problems. Provides knowledge and appreciation useful in the classroom. Term papers will be required. Note: 6 hours of undergraduate mathematics required.

**Prerequisite(s):** permission of instructor

**Restriction(s):** Students cannot enroll who are in Mathematics (085)

*Recent Term(s) Offered: summer 2019*

## **MATH 411G Problem Solving for Elementary and Middle School Teachers 3 Hours**

Integrates concepts developed in algebra, geometry, logic, statistics, probability, and elementary number theory. Students are encouraged to use problem-solving strategies, models, and technologies, and to create problems of their own.

**Restriction(s):** Students cannot enroll who are in Secondary Ed Teacher Leader (0435) or Mathematics (085)

*Recent Term(s) Offered: spring 2019; fall 2019; spring 2020; fall 2020; fall 2021*

## **MATH 413G Algebra and Technology for Middle Grades Teachers 3 Hours**

The use of graphing calculators and computer software to explore algebraic ideas including patterns, functions, equations, inequalities, linear programming, curve fitting, and practical applications of algebra and technology.

**Restriction(s):** Students cannot enroll who are in Secondary Ed Teacher Leader (0435) or Mathematics (085)

*Recent Term(s) Offered: None*

## **MATH 415G Algebra and Number Theory 3 Hours**

Survey of modern algebra and number theory. Includes number systems, divisibility, congruences, groups and their application to number theory.

*Recent Term(s) Offered: None*

## **MATH 417G Algebraic Systems 3 Hours**

The theory of finite groups and related algebraic systems. Lagrange's Theorem, Sylow Theorems, and the structure of finite groups are studied. Applications of group theory to the study of algebraic problems and symmetry.

*Recent Term(s) Offered: None*

## **MATH 421G Problem Solving for Secondary Teachers 3 Hours**

Utilizes various techniques and technology to solve mathematical problems. Integrates concepts from algebra, geometry, trigonometry, probability, statistics, number theory, discrete mathematics, linear algebra, and calculus.

**Restriction(s):** Students cannot enroll who are in Mathematics (085)

*Recent Term(s) Offered: None*

## **MATH 423G Geometry II 3 Hours**

An axiomatic development of plane hyperbolic geometry which presupposes a development of absolute geometry.

*Recent Term(s) Offered: None*

## **MATH 431G Intermediate Analysis I 3 Hours**

Topics in analysis chosen from inverse and implicit function theorems, differentiation, integration, infinite series, series of functions, and introductory functional analysis.

*Recent Term(s) Offered: fall 2020*

## **MATH 435G Partial Differential Equations 3 Hours**

Equations of first and second order; elliptic, hyperbolic and parabolic equations of mathematical physics using separation of variables and Fourier series.

*Recent Term(s) Offered: spring 2019; spring 2020; spring 2021; fall 2021*

## **MATH 439G Topology I 3 Hours**

Introduction to topology including topics selected from: topological spaces, mappings, homeomorphisms, metric spaces, surfaces, knots, manifolds, separation properties, compactness and connectedness.

*Recent Term(s) Offered: fall 2021*

## **MATH 450G Complex Variables 3 Hours**

Complex number plane, analytic functions of a complex variable, integration, power series, calculus of residues, conformal representation, applications of analytic function theory.

*Recent Term(s) Offered: spring 2019; spring 2020; spring 2021*

## **MATH 470G Introduction to Operations Research 3 Hours**

Principles and techniques of operations research including linear programming, integer programming, quality theory, sensitivity analysis, and dynamic programming.

*Recent Term(s) Offered: fall 2019*

## **MATH 482G Probability & Statistics II 3 Hours**

Multivariate probability distributions; sampling distributions, statistical inference; point and interval estimation, properties of estimators; hypothesis testing; regression and correlation; analysis of variance; non-parametric methods.

*Recent Term(s) Offered: spring 2019; spring 2020; spring 2021*

**MATH 500 Readings in Mathematics 1-3 Hours** (repeatable max of 6 hrs)

Students read and present papers that have appeared in (or have been accepted by) mathematical journals. Topics covered are determined by areas of interest. Note: Undergraduate major in mathematics required.

**Prerequisite(s):** permission of instructor

*Recent Term(s) Offered: spring 2019; summer 2019; summer 2021*

**MATH 501 Introduction to Probability and Statistics I 3 Hours**

Interpreting, analyzing, and simulating univariate and bivariate data; probability and sampling distributions; regression and chi-squared procedures from traditional and randomization approaches.

*Recent Term(s) Offered: spring 2019; spring 2020; spring 2021*

**MATH 502 Introduction to Probability and Statistics II 3 Hours**

Review of linear algebra, Markov chains, decision theory, linear programming and game theory.

*Recent Term(s) Offered: None*

**MATH 503 Introduction to Analysis 3 Hours**

Theoretical examination of selected topics in real analysis including sequences, series, limits, continuity, derivatives, and integration.

**Restriction(s):** Enrollment is limited to students in Mathematics (049)

*Recent Term(s) Offered: fall 2019; fall 2020; fall 2021*

**MATH 504 Application of Technology to Problems in Mathematics 3 Hours**

Problem solving via non-routine problems from various branches of mathematics, including, but not limited to number theory, discrete math, linear algebra, calculus, probability, and statistics.

**Restriction(s):** Enrollment is limited to students in Mathematics (049)

*Recent Term(s) Offered: fall 2019; summer 2020; fall 2020; summer 2021*

**MATH 506 Mathematical Applications for Middle Grades Teachers 3 Hours**

Sets, logic, dimensional analysis, functions and modeling, and discrete mathematics with a focus on real-world applications. Note: Middle grades math certification required.

**Prerequisite(s):** permission of instructor

**Restriction(s):** Students cannot enroll who are in Mathematics (049) or Mathematics (085)

*Recent Term(s) Offered: None*

**MATH 507 Mathematics Concepts for Elementary Teachers 3 Hours**

Course intended for graduate students in Elementary Education only. Focuses on mathematics and strategies to effectively teach Kentucky Mathematics Core Content in grades K-5.

*Recent Term(s) Offered: summer 2019; summer 2021*

**MATH 508 Number Concepts for Elementary and Middle Grades Teachers 3 Hours**

Mathematical structures of integers and rational numbers; numeration systems; elementary number theory; special sequences and numerical of relationships; applications of fractions, decimals, percents, ratio, proportion, exponents, and scientific notation.

**Restriction(s):** Students cannot enroll who are in Secondary Ed Teacher Leader (0435) or Mathematics (085)

*Recent Term(s) Offered: summer 2020*

**MATH 510 Intermediate Statistics 3 Hours**

Extended coverage of experimental design and data collection, statistical inference including confidence intervals, estimation, tests of significance, comparison of population parameters, and multiple regression.

**Prerequisite(s):** MATH 501

*Recent Term(s) Offered: summer 2019; summer 2020; summer 2021*

**MATH 511 Algebra from an Advanced Perspective 3 Hours**

Topics in algebra from an advanced perspective including analysis of functions and polynomials, number theory, and fields.

**Restriction(s):** Enrollment is limited to students in Mathematics (049)

*Recent Term(s) Offered: fall 2019; fall 2020; fall 2021*

**MATH 512 Geometry from an Advanced Perspective 3 Hours**

Topics in geometry from an advanced perspective including a theoretical examination of transformations in real and complex plane; distance congruence, and similarity in a variety of contexts; connections and applications between geometry, trigonometry, and calculus.

**Prerequisite(s):** MATH 511 or permission of instructor

*Recent Term(s) Offered: spring 2019; spring 2020; spring 2021*

**MATH 514 Mathematical Modeling and Applications 3 Hours**

Uses mathematical modeling to describe and explore real world problems using algebraic, geometric, and statistical approaches.

**Restriction(s):** Enrollment is limited to students in Mathematics (049)

*Recent Term(s) Offered: spring 2019; spring 2020; spring 2021*

**MATH 515 Introduction to Number Theory 3 Hours**

An introduction to number theory, including, but not limited to, divisibility, congruences, quadratic reciprocity, theory of primes, Fermat's Theorem, Euler's Theorem, application problems

**Restriction(s):** Enrollment is limited to students in Mathematics (049)

*Recent Term(s) Offered: None*

**MATH 517 Topics from Algebra 3 Hours**

Theory of rings, fields, and vector spaces. Topics include: polynomial rings, principal ideal domains, unique factorization domains, field extensions, Galois theory.

*Recent Term(s) Offered: None*

**MATH 529 Applied Probability 3 Hours**

Axiomatic development of the theory of probability. Introduction to Markov chains, random variables, distributions, transformations. Limit theorems and various modes of convergence.

*Recent Term(s) Offered: None*

**MATH 531 Advanced Differential Equations 3 Hours**

Power series solutions, existence and uniqueness theorems, stability and Liapunov's method, regular singular points, perturbations of periodic solutions.

*Recent Term(s) Offered: fall 2019; fall 2021*

**MATH 532 Real Analysis 3 Hours**

Function spaces, additive set functions, outer measure; measurable functions, integration.

*Recent Term(s) Offered: None*

**MATH 535 Advanced Applied Mathematics- I 3 Hours**

Eigenvalue and boundary value problems, orthogonal expressions in function spaces, classic polynomials, Sturm-Liouville theory, Fourier and Laplace transforms.

*Recent Term(s) Offered: spring 2020*

**MATH 536 Advanced Applied Mathematics- II 3 Hours**

Integral equations, calculus of variations, maximization of linear functionals, maximum gradient method.

**Prerequisite(s):** MATH 535

*Recent Term(s) Offered: None*

**MATH 539 Topology II 3 Hours**

Homotopy, homology theory.

*Recent Term(s) Offered: None*

**MATH 540 Stochastic Processes 3 Hours**

Theory and application of stochastic processes; random walks; Markov chains; Poisson processes; birth and death processes; queues; renewal and branching processes; computer simulations.

*Recent Term(s) Offered: None*

**MATH 541 Graph Theory 3 Hours**

Introduction to the basic concepts of graph theory. Topics include Eulerian circuits, Hamiltonian cycles, coloring problems and planar graphs. Note: Undergraduate major in mathematics required.

**Prerequisite(s):** permission of instructor

*Recent Term(s) Offered: spring 2021*

**MATH 542 Advanced Topics in Discrete Mathematics 3 Hours**

Combinatorics, ordered sets and lattice theory, modeling with difference equations, discrete calculus, dynamic equations on time scales.

*Recent Term(s) Offered: spring 2019*

**MATH 550 Complex Analysis 3 Hours**

Analytic continuation, conformal mapping, Riemann surfaces, and univalent functions.

*Recent Term(s) Offered: None*

**MATH 570 Topics in Operations Research 3 Hours**

Specific area(s) of operations research.

*Recent Term(s) Offered: None*

**MATH 585 Advanced Mathematical Thinking I 3 Hours**

Students will explore and identify connections between research in mathematics education and the mathematics content, from an advanced perspective, they are teaching in their courses.

**Prerequisite(s):** (MATH 501 and MATH 503 and MATH 511 and MATH 512 and MATH 515 (may be taken concurrently))

**Restriction(s):** Enrollment is limited to students in Mathematics (049)

*Recent Term(s) Offered: None*

**MATH 590 Special Topics in Mathematics 3 Hours (repeatable max of 6 hrs)**

No course description is available.

**Prerequisite(s):** permission of instructor

*Recent Term(s) Offered: spring 2019; summer 2019; fall 2020; spring 2021; fall 2021*

**MATH 595 Advanced Mathematical Thinking II 3 Hours**

Students will conduct their own research project regarding secondary students' mathematical thinking, applying what was learned in MATH 585 (Adv Mathematical Thinking I).

**Prerequisite(s):** MATH 585

**Restriction(s):** Enrollment is limited to students in Mathematics (049)

*Recent Term(s) Offered: None*

**MATH 598 Graduate Seminar: Communicating Mathematics and Technical Writing 3 Hours**

This course will familiarize graduate students in mathematics with the many different areas of mathematics and active research topics in the field as well as give them an opportunity to practice effective oral presentation skills. Students will also learn mathematical typesetting with LaTeX.

*Recent Term(s) Offered: spring 2019; spring 2021*

**MATH 599 Thesis/Research 1-6 Hours (repeatable max of 6 hrs)**

Thesis research and writing directed by faculty committee.

*Recent Term(s) Offered: spring 2019; summer 2019; fall 2019; spring 2020; fall 2020; spring 2021; summer 2021; fall 2021*

**MATH 600 Maintaining Matriculation 1-6 Hours (repeatable max of 6 hrs)**

Continued enrollment for thesis completion.

*Recent Term(s) Offered: spring 2019; summer 2019*