

MATHEMATICS (MATH)

Mathematics courses numbered below 136 are not applicable toward a major or minor in mathematics. A student who has earned credit for the listed course with a grade of "C" or better may not subsequently receive credit for the courses following in parentheses: MATH 116/MATH 123 (MATH 115); MATH 117 (MATH 115 and 116/123); MATH 118 (MATH 115, 116 and 117), MATH 119 (MATH 115, 116/123, and 118), MATH 136 (MATH 115, 116/123, 117, 118, and 119); MATH 137 (MATH 115, 116/123, 117, 118, 119, and 136); MATH 310 (MATH 109); MATH 382 (MATH 109 and 183); STAT 301 (MATH 109 and 183). Students may only take the courses MATH 116 and MATH 123 for a total of three graded attempts.

MATH 105 Corequisite Support for Algebra 1 Hour

Corequisite support for students in Math 115C, Math 116C, or Math 123. Topics include functions, graphs and fundamental concepts of algebra.

Prerequisite(s): MA 115C (may be taken concurrently) or MA 116C (may be taken concurrently) or MATH 123 (may be taken concurrently) or MATH 115E (may be taken concurrently) or MATH 116E (may be taken concurrently)

Recent Term(s) Offered: winter 2021; spring 2021; summer 2021; fall 2021; winter 2022; spring 2022; summer 2022; fall 2022; winter 2023; spring 2023; summer 2023; fall 2023

MATH 109 General Mathematics 3 Hours

Terminal course for non-science majors suggested for the student who has satisfactorily completed minimum high school mathematics requirements and needs no further work in algebra. Topics include sets, introduction to probability and statistics, geometry, and consumer mathematics. **Colonnade/Statewide General Education Code F-QR | QR**

Prerequisite(s): (ACT Math with a score of 19 or SAT Mathematics Score with a score of 510 or HS GPA Transcript with a score of 3.0)

Recent Term(s) Offered: spring 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; fall 2023

MATH 109E General Mathematics 3 Hours

Terminal course for non-science majors suggested for the student who has satisfactorily completed minimum high school mathematics requirements and needs no further work in algebra. Topics include sets, introduction to probability and statistics, geometry, and consumer mathematics. **Colonnade/Statewide General Education Code F-QR | QR**

Recent Term(s) Offered: fall 2023

MATH 112 Problem Solving and Mathematical Skills for Teachers 3 Hours

Development of mathematical skills and problem-solving techniques necessary for pre-service teachers. Topics include: number and algebra, geometry, probability and statistics. **Colonnade/Statewide General Education Code F-QR | QR**

Recent Term(s) Offered: spring 2021; fall 2021; spring 2022; fall 2022; spring 2023; fall 2023

MATH 115 Applied College Algebra 3 Hours

Intended primarily for students who are not majoring in a scientific or technical field; not intended for students whose curriculum requires trigonometry or calculus. Emphasis is on real-world problems that involve reading, writing, calculating, synthesizing, and clearly reporting results. Topics include linear, quadratic, exponential and logarithmic functions, and systems of equations. (Graphing calculator required). **Colonnade/Statewide General Education Code F-QR | QR**

Prerequisite(s): (ACT Math with a score of 22 or SAT Mathematics Score with a score of 540 or MPE - Algebra with a score of 14 or KYOTE College Algebra with a score of 14 or Compass - Algebra with a score of 50 or HS GPA Transcript with a score of 3.5)

Recent Term(s) Offered: spring 2021; summer 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; summer 2023; fall 2023

MATH 115E Applied College Algebra 3 Hours

Intended primarily for students who are not majoring in a scientific or technical field; not intended for students whose curriculum requires trigonometry or calculus. Emphasis is on real-world problems that involve reading, writing, calculating, synthesizing, and clearly reporting results. Topics include linear, quadratic, exponential and logarithmic functions, and systems of equations. (Graphing calculator required). **Colonnade/Statewide General Education Code F-QR | QR**

Prerequisite(s): (ACT Math with a score of 20 or SAT Mathematics Score with a score of 540 or MPE - Algebra with a score of 12 or KYOTE College Algebra with a score of 12 or Math 105 PreReq MATH115/116C or HS GPA Transcript with a score of 3.0) or (HS GPA Transcript with a score of 2.0 and MATH 105 (may be taken concurrently))

Recent Term(s) Offered: fall 2023

MATH 116 College Algebra 3 Hours

Graphing and problem solving are integrated throughout the study of polynomial, absolute value, rational, radical, exponential, and logarithmic functions. (Graphing calculator required.) **Colonnade/Statewide General Education Code F-QR | QR**

Prerequisite(s): (MPE - Algebra with a score of 14 or SAT Mathematics Score with a score of 540 or ACT Math with a score of 22 or KYOTE College Algebra with a score of 14 or HS GPA Transcript with a score of 3.5)

Recent Term(s) Offered: spring 2021; summer 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; summer 2023; fall 2023

MATH 116E College Algebra 3 Hours

Graphing and problem solving are integrated throughout the study of polynomial, absolute value, rational, radical, exponential, and logarithmic functions. (Graphing calculator required.) **Colonnade/Statewide General Education Code F-QR | QR**

Prerequisite(s): (ACT Math with a score of 20 or SAT Mathematics Score with a score of 540 or MPE - Algebra with a score of 12 or KYOTE College Algebra with a score of 12 or Math 105 PreReq MATH115/116C or HS GPA Transcript with a score of 3.0) or (HS GPA Transcript with a score of 2.0 and MATH 105 (may be taken concurrently))

Recent Term(s) Offered: fall 2023

MATH 117 Trigonometry 3 Hours

Unit circle; trigonometric functions and graphs; trigonometric identities and equations; right triangle trigonometry; laws of sines and cosines; DeMoivre's Theorem; vectors and applications of trigonometry. (Graphing calculator required.) Note: Four years of high school mathematics including Algebra I and II and geometry may be required. **Colonnade/Statewide General Education Code F-QR | QR**

Prerequisite(s): ACT Math with a score of 27 or (ACT Math with a score of 22 and MPE - Algebra with a score of 18) or (MATH 116 with a minimum grade of C or MATH 116E with a minimum grade of C or MA 116C with a minimum grade of C) or SAT Mathematics Score with a score of 610 or (SAT Mathematics Score with a score of 540 and MPE - Algebra with a score of 18)

Recent Term(s) Offered: spring 2021; summer 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; summer 2023; fall 2023

MATH 118 College Algebra and Trigonometry 5 Hours

Real number system, algebraic manipulations, and solutions of equations and inequalities, absolute value, exponential and logarithmic functions, trigonometry, systems of equations, complex numbers. (Graphing calculator required.) Note: Four years of high school mathematics including Algebra I and II and geometry may be required. **Colonnade/Statewide General Education Code QR**

Prerequisite(s): (ACT Math with a score of 22 and MPE - Algebra with a score of 18)

Recent Term(s) Offered: None

MATH 119 Fundamentals of Calculus 4 Hours

An introduction to calculus designed for non-science and non-technical majors. Applications are directed toward the management sciences and related areas. Not accepted for credit toward a mathematics major or minor. (Graphing calculator required.) Note: Four years of high school mathematics, including Algebra I and II and geometry, and a satisfactory score on Math Placement exam are required if MATH 116 or MATH 118 has not been met. **Colonnade/Statewide General Education Code QR**

Prerequisite(s): (MATH 116 with a minimum grade of C or MA 116C with a minimum grade of C or MATH 116E with a minimum grade of C or MATH 118 with a minimum grade of C)

Recent Term(s) Offered: None

MATH 121 Computational Problem Solving 4 Hours

Students will tackle problems ranging from elementary to advanced, using mathematical methods, algorithmic techniques, and computational methods. This course is taught jointly by mathematics and computer science faculty. Note: Enrollment in Gatton Academy of Mathematics and Science in Kentucky is required.

Corequisite(s): MATH 117

Equivalent(s): CS 121

Recent Term(s) Offered: None

MATH 123 Mathematical Applications for Business 3 Hours

Business applications of linear, quadratic, exponential and logarithmic functions, plus a brief introduction to probability, the mathematics of finance, and derivatives as they apply to problem-solving strategies in business-related fields. **Colonnade/Statewide General Education Code F-QR | QR**

Prerequisite(s): (ACT Math with a score of 22 or SAT Mathematics Score with a score of 540 or MPE - Algebra with a score of 14 or KYOTE College Algebra with a score of 14 or HS GPA Transcript with a score of 3.5) or (HS GPA Transcript with a score of 2.0 and MATH 105 (may be taken concurrently))

Recent Term(s) Offered: spring 2021; fall 2021; winter 2022; spring 2022; fall 2022; winter 2023; spring 2023; fall 2023

MATH 127 Applied Geometry 3 Hours

Euclidean geometry with historical applications, including tilings, fractals, circular and spiral designs, celestial themes, special topics in linear algebra, and the origins of perspective.

Prerequisite(s): (MATH 116 with a minimum grade of C or MATH 116E with a minimum grade of C or MA 116C with a minimum grade of C or ACT Math with a score of 22 or MPE - Algebra with a score of 18 or ACT Math with a score of 27)

Recent Term(s) Offered: None

MATH 136 Calculus I 4 Hours

A course in one-variable calculus including topics from analytic geometry. Limits, derivatives, integration, and applications of polynomial, rational, trigonometric and transcendental functions. Includes lecture and recitation. Note: Four years of high school mathematics including Algebra II, geometry may be required. **Colonnade/Statewide General Education Code F-QR | QR**

Prerequisite(s): ((ACT Math with a score of 27 or SAT Mathematics Score with a score of 640) or (ACT Math with a score of 22 and MPE - Algebra with a score of 20) or (SAT Mathematics Score with a score of 540 and MPE - Algebra with a score of 20) and MPTE - Trigonometry with a score of 10 or (MATH 117 with a minimum grade of C or MA 117C with a minimum grade of C or MATH 118 with a minimum grade of C))

Recent Term(s) Offered: spring 2021; summer 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; summer 2023; fall 2023

MATH 137 Calculus II 4 Hours

A second course in one-variable calculus including topics from analytic geometry. Methods of integration, sequences and series, polar and parametric functions. Includes lecture and recitation.

Prerequisite(s): MATH 136 with a minimum grade of C

Recent Term(s) Offered: spring 2021; summer 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; summer 2023; fall 2023

MATH 142 Calculus with Applications for Life Sciences 5 Hours

Exponential and logarithmic functions, derivatives, integration, first order differential equations, and systems of linear equations, with major emphasis on applications in life sciences. Note: Four years of high school mathematics, including Algebra I and II, geometry, and a course that includes trigonometry is required if MATH 117 and MATH 118 has not been met. **Colonnade/Statewide General Education Code F-QR | QR**

Prerequisite(s): (ACT Math with a score of 22 and MPE - Algebra with a score of 20 and MPTE - Trigonometry with a score of 10) or (ACT Math with a score of 27 and MPTE - Trigonometry with a score of 10) or (MATH 117 (may be taken concurrently) with a minimum grade of C or MA 117C (may be taken concurrently) with a minimum grade of C or MATH 118 with a minimum grade of C)

Recent Term(s) Offered: None

MATH 183 Introductory Statistics 3 Hours

Introduction to elementary probability theory. The analysis of data by means of frequency distributions and the statistics which describe them. The binomial and normal probability distributions. Statistical inference. Emphasis is on applied real world problems. Not accepted for credit toward a mathematics major or minor. **Colonnade/Statewide General Education Code F-QR | QR**

Prerequisite(s): (MPE - Algebra with a score of 14 or SAT Mathematics Score with a score of 540 or ACT Math with a score of 22 or KYOTE College Algebra with a score of 14 or MATH 109 with a minimum grade of C or MA 109C with a minimum grade of C or MATH 112 with a minimum grade of C or MATH 115 with a minimum grade of C or MA 115C with a minimum grade of C or MATH 116 with a minimum grade of C or MA 116C with a minimum grade of C or MATH 117 with a minimum grade of C or MATH 123 with a minimum grade of C or MATH 136 with a minimum grade of C or MATH 142 with a minimum grade of C or MATH 109E with a minimum grade of C or MATH 116E with a minimum grade of C or MATH 115E with a minimum grade of C or HS GPA Transcript with a score of 3.5)

Recent Term(s) Offered: spring 2021; summer 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; summer 2023; fall 2023

MATH 205 Number Systems and Number Theory for Teachers 3 Hours

Development of conceptual understanding of elementary place value, operations on whole numbers and integers, number theory, basic algebra and functions.

Prerequisite(s): MATH 112 with a minimum grade of C or MATH 115 with a minimum grade of C or MATH 115E with a minimum grade of C or MA 115C with a minimum grade of C or MATH 116 with a minimum grade of C or MATH 116E with a minimum grade of C or MA 116C with a minimum grade of C or MATH 117 with a minimum grade of C or MATH 123 with a minimum grade of C or MATH 136 with a minimum grade of C or MATH 183 with a minimum grade of C

Restriction(s): Enrollment is limited to students in Special Ed: LBD and Elm Edu (5003) , Elementary Education (527) , Exceptional Ed - LBD and MSD (553) , Middle Grades Education (579) , Mathematics (728) , Mathematics-Prep (728P) , Middle Grades Mathematics (730) or Middle Grades Mathematics-Prep (730P)

Recent Term(s) Offered: spring 2021; summer 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; fall 2023

MATH 206 Fundamentals of Geometry for Teachers 3 Hours

Conceptual development of fundamental concepts of geometry and measurement. Note: Completion of general education math course is required.

Prerequisite(s): MATH 205 with a minimum grade of C

Restriction(s): Enrollment is limited to students in Special Ed: LBD and Elm Edu (5003) , Elementary Education (527) , Exceptional Ed - LBD and MSD (553) , Middle Grades Education (579) , Mathematics (728) , Mathematics-Prep (728P) , Middle Grades Mathematics (730) or Middle Grades Mathematics-Prep (730P)

Recent Term(s) Offered: spring 2021; summer 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; fall 2023

MATH 237 Multivariable Calculus 4 Hours

Topics in real-valued functions of several variables including directional derivatives, implicit functions, gradient, Taylor's Theorem, maxima, minima, and Lagrange multipliers. Differential calculus of vector-valued functions including chain rule and Inverse Function Theorem. Multiple integrals, line integrals, surface integrals, Stokes' and Green's Theorems.

Prerequisite(s): MATH 137 with a minimum grade of C

Recent Term(s) Offered: spring 2021; fall 2021; spring 2022; fall 2022; spring 2023; fall 2023

MATH 240 Geometry in Art and Architecture 3 Hours

Euclidean geometry with historical applications in art and architecture, such as tiling, circular and spiral designs, designs of the great cathedrals in Europe, Buddhist stupas in Asia, Islamic art, the development of visual perspective, and musical ratios. **Colonnade/Statewide General Education Code K-SY**

Prerequisite(s): 21 hours of Foundations and Explorations Courses, or junior status and (MATH 112 with a minimum grade of B or MATH 116 with a minimum grade of B or MATH 115 with a minimum grade of B or MATH 117 with a minimum grade of B or MATH 109 with a minimum grade of B or MATH 136 with a minimum grade of B or MATH 142 with a minimum grade of B or MATH 183 with a minimum grade of B)

Equivalent(s): HUM 240

Recent Term(s) Offered: None

MATH 270 The Mathematics of Social Justice 3 Hours

Use of mathematical and statistical tools to examine social justice topics on local, regional, national, and global scales. **Colonnade/Statewide General Education Code K-LG**

Prerequisite(s): 21 hours of Foundations and Explorations Courses, or junior status

Recent Term(s) Offered: spring 2023

MATH 275 Introductory Topics in Mathematics 1-3 Hours (repeatable max of 3 hrs)

Varied topics selected to give students an early introduction to interesting mathematical problems or applications not found in the foundation sequence. Note: Permission of instructor required.

Prerequisite(s): MATH 136

Recent Term(s) Offered: winter 2021; spring 2021; fall 2021; spring 2022; fall 2023

MATH 295 Introduction to Research Methodology 1 Hour

To familiarize Ogden Research Scholars and other interested students with the fundamentals of choosing a research topic, performing a bibliographical search on a subject, classification of instruments, data taking, data reduction, professional ethics and related topics. The common points of research methodology in the different scientific areas will be emphasized, with examples drawn from various disciplines. Computers will be utilized. (Course does not count toward any major or minor.) Note: Ogden Research Scholar, or 3.2 grade point average at the end of freshman year or Ogden College faculty member recommendation is required.

Equivalent(s): ENGR 295, CHEM 295, PHYS 295, CS 295, BIOL 295

Recent Term(s) Offered: None

MATH 302 Introduction to Advanced Mathematics for Middle Grades Teachers 3 Hours

Development of skills in reasoning, justification, abstraction, generalization, and making connections through the study of selected topics from logic, sets, relations and functions, combinatorics, number theory, graph theory, and matrix algebra, as appropriate for middle grades mathematics teachers.

Prerequisite(s): MATH 136 (may be taken concurrently) with a minimum grade of C

Recent Term(s) Offered: fall 2021; fall 2022; fall 2023

MATH 304 Functions, Applications and Explorations 3 Hours

In-depth study of mathematical topics used in teaching pre-calculus and transition-to-calculus courses at the middle and secondary school levels. Modeling with linear, exponential, and trigonometric functions; curve fitting; discrete and continuous models.

Prerequisite(s): MATH 137 with a minimum grade of C or MATH 302 with a minimum grade of C

Recent Term(s) Offered: spring 2021; spring 2022; spring 2023

MATH 305 Introduction to Mathematical Modeling 3 Hours

Theory and computer implementation of mathematical models. Deterministic, stochastic, discrete, continuous, and matrix models. Introduction to advanced topics such as linear algebra, differential and difference equations, probability, stochastic processes, and dynamical systems.

Prerequisite(s): MATH 137 with a minimum grade of C

Recent Term(s) Offered: fall 2022

MATH 306 Applied and Computational Linear Algebra 3 Hours

Basic concepts and computational techniques of matrix and linear algebra. Practical methods using computer software for small-to-large data sets. Applications in economics, finance, informatics, statistics, and social, engineering, physical and biological sciences. Computer assignments are required. Not accepted for credit toward a mathematics major or minor.

Prerequisite(s): (MATH 116 with a minimum grade of C or MATH 116E with a minimum grade of C or MA 116C with a minimum grade of C) and (MATH 183 with a minimum grade of C or MATH 136 with a minimum grade of C or MATH 142 with a minimum grade of C)

Recent Term(s) Offered: None

MATH 307 Introduction to Linear Algebra 3 Hours

Systems of linear equations, matrix algebra, vector spaces, inner product spaces, linear transformations, eigenvectors, quadratic forms.

Prerequisite(s): (MATH 137 with a minimum grade of C or MATH 136 with a minimum grade of A or MATH 142 with a minimum grade of A) or (MATH 136 with a minimum grade of C and CS 290 with a minimum grade of C)

Recent Term(s) Offered: spring 2021; fall 2021; spring 2022; fall 2022; spring 2023; fall 2023

MATH 308 Rational Numbers and Data Analysis for Teachers 3 Hours

Conceptual development of rational number system, including operations with and relationships among fractions, decimals, and percents; elementary probability and statistics.

Prerequisite(s): MATH 205 with a minimum grade of C

Restriction(s): Enrollment is limited to students in Special Ed: LBD and Elm Edu (5003), Elementary Education (527), Mathematics (728), Mathematics-Prep (728P), Middle Grades Mathematics (730) or Middle Grades Mathematics-Prep (730P)

Recent Term(s) Offered: spring 2021; summer 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; fall 2023

MATH 310 Introduction to Discrete Mathematics 3 Hours

Introduction to discrete topics. Development of skills in abstraction and generalization. Set theory, functions and relations, mathematical induction, elementary propositional logic, quantification, truth tables, validity; counting techniques, pigeonhole principle, permutations and combinations; recurrence relations and generating functions; elementary graph theory, isomorphisms, trees.

Prerequisite(s): MATH 137 with a minimum grade of C

Recent Term(s) Offered: spring 2021; fall 2021; spring 2022; fall 2022; spring 2023; fall 2023

MATH 315 Theory of Numbers 3 Hours

A study of the arithmetic of the integers, divisibility, prime numbers, factorization, diophantine equations, congruences, quadratic residues.

Prerequisite(s): MATH 307 with a minimum grade of C

Recent Term(s) Offered: None

MATH 317 Introduction to Algebraic Systems 3 Hours

Introduction to groups, rings, polynomial rings, integral domains, and fields.

Prerequisite(s): MATH 307 with a minimum grade of C and MATH 310 with a minimum grade of C

Recent Term(s) Offered: fall 2021; fall 2022; fall 2023

MATH 323 Geometry I 3 Hours

An axiomatic development of Euclidean and absolute plane geometry.

Prerequisite(s): MATH 310 with a minimum grade of C

Recent Term(s) Offered: fall 2021; fall 2022; fall 2023

MATH 331 Differential Equations 3 Hours

Methods of solution of differential equations, existence and nature of solutions, Laplace transform method, infinite series and numerical solutions, and applications.

Prerequisite(s): MATH 137 with a minimum grade of C

Recent Term(s) Offered: spring 2021; fall 2021; spring 2022; summer 2022; fall 2022; spring 2023; fall 2023

MATH 337 Elements of Real Analysis 3 Hours

Basic concepts and techniques of real analysis, including proofs by induction and contradiction, the number system, functions of real variables, sets, series and sequences, cardinality, continuity, convergence, and elementary topology.

Prerequisite(s): MATH 237 with a minimum grade of C and MATH 307 with a minimum grade of C and MATH 310 with a minimum grade of C

Recent Term(s) Offered: spring 2021; spring 2022; spring 2023

MATH 350 Advanced Engineering Mathematics 3 Hours

Special topics in Laplace transforms, linear algebra and complex analysis. Designed for engineering students.

Prerequisite(s): MATH 331

Recent Term(s) Offered: None

MATH 370 Applied Techniques in Mathematics 3 Hours

Matrices, systems of ordinary differential equations, complex variables, and at least one of the topics from Fourier analysis, numerical analysis or optimization (linear programming, Lagrange multipliers).

Prerequisite(s): MATH 237 with a minimum grade of C and MATH 331 with a minimum grade of C

Recent Term(s) Offered: spring 2021; spring 2023

MATH 371 Advanced Computational Problem Solving 3 Hours

Problem-solving tools and techniques, with an emphasis on mathematical reasoning, algorithmic techniques, and computational methods. Techniques and tools are applied to (research) areas of interest to enrolled students, in the context of a project involving program design and implementation. The course is taught jointly by mathematics and computer science faculty. Note: Enrollment in the Gatton Academy of Mathematics and Science or Honors Program eligibility at WKU required.

Prerequisite(s): CS 180 with a minimum grade of C and MATH 136 (may be taken concurrently)

Equivalent(s): CS 371

Recent Term(s) Offered: spring 2021; spring 2022; spring 2023

MATH 382 Probability and Statistics I 3 Hours

Axioms and laws of probability; discrete and continuous probability distributions; multivariate distributions; random variables; expectation; moment generating functions; Central Limit Theorem.

Prerequisite(s): MATH 310 with a minimum grade of C and MATH 237 (may be taken concurrently)

Recent Term(s) Offered: fall 2021; fall 2022; fall 2023

MATH 398 Seminar 1 Hour (repeatable max of 3 hrs)

Students will work on a topic of interest under the direction of a mathematics faculty member, who will set the requirements for the course. Mathematics majors could have the opportunity to continue this work in MATH 498.

Prerequisite(s): MATH 237 with a minimum grade of C

Recent Term(s) Offered: spring 2021

MATH 403 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.

Prerequisite(s): MATH 206 with a minimum grade of C and MATH 302 with a minimum grade of C

Recent Term(s) Offered: spring 2021; spring 2022; spring 2023

MATH 405 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 137 with a minimum grade of C and (MATH 237 with a minimum grade of C or MATH 307 with a minimum grade of C or MATH 310 with a minimum grade of C) and (CS 146 with a minimum grade of C or CS 180 with a minimum grade of C)

Equivalent(s): CS 405

Recent Term(s) Offered: fall 2021; fall 2022; fall 2023

MATH 406 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.

Prerequisite(s): MATH 237 with a minimum grade of C and MATH 307 with a minimum grade of C and MATH 331 with a minimum grade of C and (MATH 405 with a minimum grade of C or CS 405 with a minimum grade of C)

Recent Term(s) Offered: spring 2023

MATH 409 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. This course cannot be accepted as part of the 35-hour requirement for the non-certifiable mathematics major. Term papers will be required. Note: Six hours of approved mathematics courses at the 300 and/or 400 level or permission of instructor required.

Recent Term(s) Offered: None

MATH 411 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.

Prerequisite(s): MATH 206 with a minimum grade of C and MATH 302 with a minimum grade of C and MATH 308 with a minimum grade of C

Recent Term(s) Offered: fall 2021; fall 2022; fall 2023

MATH 413 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.

Prerequisite(s): (MATH 302 with a minimum grade of C or MATH 137 with a minimum grade of C)

Recent Term(s) Offered: fall 2021; fall 2022; fall 2023

MATH 415 Algebra and Number Theory 3 Hours

An integrated survey of modern algebra and number theory. Topics include number systems, divisibility, congruences, groups and their application to number theory.

Prerequisite(s): (MATH 315 with a minimum grade of C or MATH 317 with a minimum grade of C)

Recent Term(s) Offered: None

MATH 417 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.

Prerequisite(s): MATH 317 with a minimum grade of C

Recent Term(s) Offered: spring 2022; spring 2023

MATH 421 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. Note: Permission of instructor may be required.

Prerequisite(s): MATH 137 with a minimum grade of C and (MATH 307 with a minimum grade of C or MATH 310 with a minimum grade of C)

Recent Term(s) Offered: spring 2021; spring 2022; spring 2023

MATH 423 Geometry II 3 Hours

An axiomatic development of hyperbolic geometry based on the hyperbolic parallel postulate and the absolute geometry developed in MATH 323, including an emphasis on contrasts with Euclidean geometry. Note: Permission of instructor may be required.

Prerequisite(s): MATH 323 with a minimum grade of C and MATH 137 with a minimum grade of C

Recent Term(s) Offered: None

MATH 431 Intermediate Analysis I 3 Hours

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

Prerequisite(s): MATH 337 with a minimum grade of C

Recent Term(s) Offered: fall 2022; fall 2023

MATH 435 Partial Differential Equations 3 Hours

Equations of first and second order; elliptic, hyperbolic and parabolic equations; Sturm-Liouville theory; applications to equations of mathematical physics using separation of variables and Fourier series.

Prerequisite(s): MATH 237 with a minimum grade of C and MATH 307 with a minimum grade of C and MATH 331 with a minimum grade of C

Recent Term(s) Offered: spring 2021; spring 2022; spring 2023

MATH 439 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. Note: Permission of instructor may be required.

Prerequisite(s): MATH 317 with a minimum grade of C

Recent Term(s) Offered: fall 2021; fall 2022

MATH 450 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.

Prerequisite(s): MATH 237 with a minimum grade of C

Recent Term(s) Offered: spring 2021; spring 2022; spring 2023

MATH 470 Introduction to Operations Research 3 Hours

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

Prerequisite(s): MATH 237 with a minimum grade of C and MATH 307 with a minimum grade of C

Recent Term(s) Offered: None

MATH 473 Introduction to Graph Theory 3 Hours

Fundamental concepts, key ideas and tools in graph theory, with an emphasis on proof methods, algorithms and applications. Techniques and tools are applied to practical optimization problems and other areas of mathematics and computer science. Note: Permission of instructor may be required.

Prerequisite(s): MATH 307 with a minimum grade of C and MATH 310 with a minimum grade of C

Equivalent(s): CS 473

Recent Term(s) Offered: fall 2022

MATH 475 Selected Topics in Mathematics 1-3 Hours (repeatable max of 6 hrs)

A consideration of special topics to acquaint the advanced undergraduate student with significant problems and developments of current interest in mathematics. Topics may vary each semester offered. Note: Permission of instructor required.

Recent Term(s) Offered: spring 2021; fall 2021; fall 2022; spring 2023

MATH 482 Probability and 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.

Prerequisite(s): MATH 237 with a minimum grade of C and MATH 382 with a minimum grade of C

Recent Term(s) Offered: spring 2021; spring 2022; spring 2023

MATH 490 Seminar in Middle Grades Mathematics 1-3 Hours (repeatable max of 3 hrs)

Designed to integrate the ideas and techniques students have encountered in the middle grades mathematics major. Students undertake independent investigations in mathematics. Papers and oral presentations are required. Note: Completion of at least 25 hours of mathematics courses with grades of C or better, required for the Middle Grades Mathematics Degree.

Prerequisite(s): (MATH 411 (may be taken concurrently) or MATH 421 (may be taken concurrently))

Recent Term(s) Offered: spring 2021; fall 2021; spring 2022; fall 2022; fall 2023

MATH 497 Senior Seminar in Mathematical Economics 1 Hour

This course is designed to integrate the ideas and techniques students have encountered in their work in mathematics and economics. Students will study research articles and/or undertake independent investigations in mathematical economics.

Restriction(s): Students with a semester level of Academy Junior, Academy Senior, Freshman, Junior or Sophomore may **not** enroll.

Enrollment is limited to students in Mathematical Economics (731)

Equivalent(s): ECON 497

Recent Term(s) Offered: spring 2022

MATH 498 Senior Seminar 1-3 Hours (repeatable max of 3 hrs)

Students will study articles in current mathematical journals or undertake independent investigations in mathematics. Written and oral presentations will be required. Note: Permission of instructor may be required.

Prerequisite(s): MATH 237 with a minimum grade of C and MATH 317 with a minimum grade of C

Restriction(s): Students with a semester level of Academy Junior, Academy Senior, Freshman, Junior or Sophomore may **not** enroll.

Recent Term(s) Offered: spring 2021; fall 2021; spring 2022; fall 2022; spring 2023; fall 2023