MATHEMATICS (MATH)

MATH 101 Review in Mathematics 1 Credit
Review of mathematical concepts and computations. Content will vary and topics will be chosen to prepare students for a specific subsequent course.
Prerequisites: Permission of instructor.

MATH 105 Elements of Mathematics I 3 Credits
Mathematics for the prospective elementary teacher with an emphasis on understanding mathematical reasoning and processes. Topics include problem solving, set theory, number theory, numeration systems, the integers and rational numbers.
Prerequisites: Appropriate mathematics placement test score and interview, and permission of instructor.

MATH 107 Career Math 3 Credits
Covers material designed for career technical or general studies students who need to study particular mathematical topics. Topics include measurement, algebra, geometry, trigonometry, graphs, and/or finance. These are presented on an introductory level and the emphasis is on applications.

MATH 108 Technical Mathematics 4 Credits
Covers material designed for career technical or general studies students who need to study particular mathematical topics. Topics may include measurement, algebra, geometry, trigonometry, graphs, and/or finance. These are presented on an introductory level and the emphasis is on applications.

MATH 110 Mathematical Investigations-GTMA13 Credits
Investigations into mathematical concepts approached through the lens of real-world applications and projects. Specific content includes problem solving, mathematical models, financial mathematics, set theory, logic, probability, descriptive statistics, and the appropriate use of technology.
Prerequisites: MATC 090 or equivalent or appropriate mathematics placement test score.
Essential Learning Categories: Mathematics See the program requirements list to determine the minimum level math needed
Colorado Guaranteed Transfer (GT) Pathways General Education Curriculum
Terms Typically Offered: Fall, Spring, Summer.

MATH 113 College Algebra-GTMA14 Credits
College-level treatment of algebra. Topics include algebraic properties of the integers, rationals, real and complex numbers; techniques for manipulation of expressions; techniques for solving linear, non-linear, absolute value equations, and inequalities; techniques for solving systems of equations; the Cartesian plane, relations and functions; properties and graphs of polynomial, rational, exponential, logarithmic and inverse functions; conic sections.
Prerequisites: MATC 092 or equivalent, or appropriate mathematics placement test score.
Essential Learning Categories: Mathematics See the program requirements list to determine the minimum level math needed
Colorado Guaranteed Transfer (GT) Pathways General Education Curriculum
Terms Typically Offered: Fall, Spring, Summer.

MATH 119 Precalculus Mathematics-GTMA15 Credits
An in-depth treatment of the mathematics essential to Calculus. Topics include the Cartesian plane, functions; polynomial, rational, exponential, logarithmic, inverse, circular and trigonometric functions; solving inequalities and systems of equations Additional topics may include matrices, determinants and vectors.
Prerequisites: MATH 113 or equivalent, or appropriate mathematics placement test score.
Essential Learning Categories: Mathematics See the program requirements list to determine the minimum level math needed
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MATH 121 Calculus for Business 3 Credits
An introduction to calculus with an emphasis on applications to business and economics. Topics include linear and quadratic functions, limits, continuity, differentiation, integration, the logarithmic and exponential functions, and applications. Computer algebra systems will be used where applicable. Current college algebra skills and graphic calculator are required.
Prerequisites: MATH 113 or equivalent, or appropriate mathematics placement test score.

MATH 127 Mathematics of Finance 3 Credits
Simple interest, simple discount, compound interest, continuously compounded interest, annuities, perpetuities, capitalization, determining payment size, determining outstanding principal, and constructing amortization schedules, including the derivation of mathematical formulae and the methods for solving many financial problems.
Prerequisites: MATH 113 or permission of instructor.

MATH 130 Trigonometry 3 Credits
A college-level treatment of trigonometry. Topics include the Cartesian plane, functions, inverse functions, the circular function, trigonometric functions, graphs of trigonometric functions, trigonometric identities, solving trigonometric equations, inverse trigonometric functions, triangle solution techniques and vectors.
Prerequisites: MATH 113 or equivalent, or appropriate mathematics placement test score.

MATH 135 Engineering Calculus I 4 Credits
Introduction to differentiation and integration of functions of a single variable. Emphasis on computational aspects. Includes functions, limits, continuity, differentiation, related rates, optimization problems, graphing, integration and applications.
Prerequisites: MATH 119, or appropriate mathematics placement score.

MATH 136 Engineering Calculus II 4 Credits
Continuation of MATH 135 Engineering Calculus I. Includes techniques of integration, trigonometric and hyperbolic functions, inverse, logarithmic and exponential functions, sequences, series, conic sections, polar coordinates and parametric equations.
Prerequisites: MATH 135 or MATH 151.

MATH 141 Analytical Geometry 3 Credits
A college-level treatment of analytic geometry. Topics include Cartesian coordinate systems, distance, parallel and perpendicular lines and planes, the locus of a condition, generalizations of lines, planes and parabolas, polar coordinates and vectors in two and three dimensions.
Prerequisites: MATH 130 or permission of instructor.
MATH 146 Calculus for Biological Sciences 5 Credits
An introduction to calculus with an emphasis on applications to biology. Topics include functions, properties and graphs of polynomials, rational functions, the trigonometric, inverse, exponential and logarithmic functions, limits, continuity, differentiation, related rates, min-max problems, integration and applications of biology. Prerequisites: MATH 113 or permission of instructor.

MATH 147 Introduction to Computer Algebra Systems 1 Credit
Introduction to computer algebra using an appropriate computer algebra system (CAS) such as Maple, Mathematica, Derive, etc. Topics will include the syntax and simple programming of the CAS used. Assignments and projects will emphasize applications in Calculus. Prerequisites: MATH 119.

MATH 149 Honors Mathematics-GTMA13 Credits
An in-depth exploration of mathematical concepts, with an emphasis on the process of mathematical discovery. Topics are left to the discretion of the instructor, and typically include an introduction to more advanced topics such as group theory or graph theory. This course fulfills the essential learning requirement for students in the Honors Program. Prerequisites: Permission of instructor.

MATH 150 Topics and Careers in Mathematics 1 Credit
Introduction to the nature of mathematical thinking. Advanced topics and applications of mathematics and statistics will be presented at an introductory level. Career options will be investigated. Prerequisites: MATH 151 or MATH 135 or MATH 146 (any of these courses may be taken concurrently with MATH 150).

MATH 151 Calculus I-GT-MA1 5 Credits
A continuation of MATH 151 Calculus I. Topics include techniques of integration, trigonometric functions, inverse, logarithmic and exponential functions, sequences, series, conic sections, polar coordinates and parametric equations. Prerequisites: MATH 119, or appropriate mathematics placement test score.

Essential Learning Categories: Mathematics See the program requirements list to determine the minimum level math needed Colorado Guaranteed Transfer (GT) Pathways General Education Curriculum

MATH 152 Calculus II 5 Credits
A continuation of MATH 151 Calculus I. Topics include techniques of integration, trigonometric functions, hyperbolic functions, inverse, logarithmic and exponential functions, sequences, series, conic sections, polar coordinates and parametric equations. Prerequisites: MATH 151.

MATH 196 Topics 1-4 Credits
Course may be taken multiple times up to maximum of 15 credit hours.

MATH 205 Elements of Mathematics II-GTMA13 Credits
Decimal numbers, probability, statistics, geometry, and the metric system. A continuation of MATH 105 designed for the prospective elementary teacher. Prerequisites: MATH 105 or permission of instructor.

Essential Learning Categories: Mathematics See the program requirements list to determine the minimum level math needed Colorado Guaranteed Transfer (GT) Pathways General Education Curriculum

MATH 225 Computational Linear Algebra 3 Credits
Computational approach to systems of equations, vector spaces, matrices, matrix transformations, eigenvalues, as well as their applications. Software for linear algebra computations is introduced and utilized. Prerequisites: MATH 151 or MATH 135 or MATH 146.

MATH 236 Differential Equations and Linear Algebra 4 Credits
Introduction to ordinary differential equations and linear algebra. Topics covered include ordinary differential equations, systems of linear equations, matrices, determinants, vector spaces, linear transformations, and systems of linear differential equations. Prerequisites: MATH 152 or MATH 136.

MATH 240 Introduction to Advanced Mathematics 4 Credits
An introduction to writing mathematical proofs. This course is designed to provide students with a transition from computationally-based lower level classes to proof-based upper level classes. The primary goal of the course is to train students to construct and analyze rigorous mathematical proofs. Topics include introductory logic, set theory, relations, functions, induction, equivalence relations, partitions and combinatorics. Prerequisites: MATH 152.

MATH 253 Calculus III 5 Credits
Vectors in three-dimensional space, vector functions, partial derivatives, directional derivative and multiple integrals. Prerequisites: MATH 136 or MATH 152.

MATH 260 Differential Equations 3 Credits
Techniques of solving differential equations of order one, linear differential equations, linear equations with constant coefficients, non-homogeneous equations, variation of parameter techniques, and Laplace transform methods. Prerequisites: MATH 152 or MATH 136.

MATH 296 Topics 1-3 Credits
Course may be taken multiple times up to maximum of 15 credit hours.

MATH 301 Mathematics for Elementary Teachers 3 Credits
A selection of mathematics topics addressing content and standards for elementary education. Strong emphasis on written and oral communication. Prerequisites: MATH 205 and formal acceptance into the Teacher Education Program, or permission of instructor.

MATH 305 Euclidean Geometry 3 Credits
Development of Euclidean Geometry. Topics include basic concepts of logic, axiomatic proofs, inductive reasoning, analytic geometry, applications of technology, and van Hiele levels of learning. Intended for students seeking elementary teacher licensure. Prerequisites: MATH 301, and MATH 151 or MATH 146.

MATH 310 Number Theory 3 Credits
Classical number theory including the fundamental theorem of arithmetic, congruences, and linear diophantine equations. Prerequisites: MATH 240.

MATH 325 Linear Algebra 3 Credits
Proof-based treatment of linear algebra. Topics include vector spaces, linear transformations, eigenvalues, and orthogonality. Prerequisites: MATH 225 and MATH 240.
MATH 340 Ethnomathematics3 Credits
Study of mathematics within cultures, especially small-scale indigenous cultures. Through the lens of culture, students can compare/contrast mathematics systems, their logical structures, and their modes of expression.
Prerequisites: MATH 240 or MATH 301 or permission of instructor.

MATH 352 Advanced Calculus3 Credits
Proof-based treatment of calculus of one real variable with focus on axiomatic development. Topics include completeness of the real numbers, limits, continuity, derivatives, integrals, and the Fundamental Theorem of Calculus.
Prerequisites: MATH 240.

MATH 360 Methods of Applied Mathematics3 Credits
Selection of techniques in applied mathematics of particular use to scientists and engineers. Topics include vector analysis, partial differential equations and transform techniques. Applications are stressed.
Prerequisites: MATH 253, and MATH 236 or MATH 260.

MATH 361 Numerical Analysis4 Credits
Elementary numerical analysis using the hand-held programmable calculator including Taylor's theorem, truncating errors, iteration processes, least squares methods, numerical solution of algebraic and transcendental equations, systems of equations, ordinary and partial differential equations, integral equations, interpolation, finite differences, eigenvalue problems, relaxation techniques, approximations, and error analysis.
Prerequisites: MATH 152 or MATH 136.

MATH 362 Fourier Analysis3 Credits
Introduction to continuous and discrete Fourier analysis. Topics include signals as vectors, matrices, and functions; orthogonality and correlation; expansions and transforms; Fourier series and frequency analysis; filtering, thresholding and compression; analysis of accuracy, including aliasing and convergence; Fourier and inverse Fourier transforms; discrete and inverse discrete Fourier transforms.
Prerequisites: MATH 152 or MATH 136.

MATH 365 Mathematical Modeling3 Credits
Bridge between calculus and the application of mathematics. Investigation of meaningful and practical problems encompassing the disciplines of mathematical sciences, operations research, engineering, management sciences and life sciences.
Prerequisites: MATH 136 or MATH 152, and one of the following: MATH 225, MATH 236, MATH 240, MATH 253, MATH 260, or STAT 200.
Terms Typically Offered: Spring.

MATH 366 Methods of Applied Mathematics I3 Credits
Treatment of numerical methods used to solve problems in applied mathematics. Topics include iteration, interpolation, numerical integration and differentiation, numerical linear algebra, numerical solutions of matrix eigenvalue problems, and numerical solutions of ordinary and partial differential equations.
Prerequisites: MATH 360; and CSCI 110/CSCI 110L or CSCI 111 or CSCI 130 or CSCI 310.

MATH 369 Discrete Structures I3 Credits
Elementary logic, induction, recursion, recurrence relations, sets, combinatorics, relations, functions, graphs, trees, and elementary abstract structures.
Prerequisites: MATH 152 or MATH 136; and CSCI 110/CSCI 110L or CSCI 111 or CSCI 130.

MATH 370 Discrete Structures II3 Credits
Applications of logic, Boolean algebra and computer logic, abstract structures, coding theory, finite-state machines, and computability.
Prerequisites: MATH 369 or both MATH 240 and CSCI 111.

MATH 380 History of Mathematics3 Credits
History of mathematics from antiquity to the present with emphasis upon the development of mathematics concepts and the people involved.
Prerequisites: MATH 152.

MATH 386 Geometries4 Credits
A study of Euclidean and non-Euclidean geometries. This course examines the differences in their axiom systems and their models, and how notions in Euclidean geometry are interpreted in non-Euclidean systems.
Prerequisites: MATH 240.

MATH 389 Independent Study1-3 Credits
Course may be taken multiple times up to maximum of 6 credit hours.

MATH 390 Topics1-3 Credits
Course may be taken multiple times up to maximum of 15 credit hours.

MATH 394 Mathematics Colloquium1 Credit
A weekly series of talks on a wide range of contemporary mathematics will be given by local faculty and others. Students must provide written commentary on these talks.
Prerequisites: Permission of instructor.

MATH 395 Independent Study1-3 Credits
Course may be taken multiple times up to maximum of 15 credit hours.

MATH 396 Topics1-3 Credits
Course may be taken multiple times up to maximum of 6 credit hours.

MATH 397 Structured Research1-4 Credits
Course may be taken multiple times up to maximum of 12 credit hours.

MATH 420 Introduction to Topology3 Credits
Introduction to point set topology. Topics include topological spaces, metric spaces, connectedness, compactness, the separation axioms, and the Tychonoff theorem.
Prerequisites: MATH 310 or MATH 325 or MATH 352.

MATH 430 Mathematical Logic3 Credits
Introduction to the classical areas of mathematical logic (model theory, proof theory, the theory of computation, complexity theory and set theory), the relationships these sub-disciplines have with each other and their relationships to the foundations of mathematics, computational science, computer science and the philosophy of mathematics.
Prerequisites: MATH 240 or MATH 369.

MATH 450 Complex Variables3 Credits
Algebra of complex numbers, analyticity, differentiation and integration of complex functions, Cauchy's integral formulae, and series.
Prerequisites: MATH 240.

MATH 452 Intro to Real Analysis I3 Credits
Introduction to real analysis from a general metric space perspective. Topics may include point set topology, completeness, compactness and connected sets, sequences, series, continuity, integration and sequences and series of functions.
Prerequisites: MATH 253 and MATH 352.
MATH 453 Intro to Real Analysis I 3 Credits
Selected topics in advanced real analysis chosen by instructor.
Prerequisites: MATH 452.

MATH 460 Advanced Linear Algebra 3 Credits
Characteristics and minimal polynomial, Cayley-Hamilton Theorem, invariant subspaces, bilinear forms, primary decomposition theorem, dual vector spaces.
Prerequisites: MATH 325.

MATH 466 Methods of Applied Mathematics III 3 Credits
Exploration of advanced methods of applied mathematics with an emphasis on extending basic methods and concepts. Specific content may vary but will typically include contemporary techniques in advanced mathematics, modeling and data analysis.
Prerequisites: MATH 366.

MATH 484 Senior Seminar I 2 Credits
An introduction to conducting mathematical research with discussion of various research topics, including how to read and analyze articles in mathematics. Presentations and papers will be required.
Prerequisites: MATH 452 or MATH 490 or MATH 366 or STAT 350.

MATH 490 Abstract Algebra I 3 Credits
Introduction to the theory of algebraic structures. Topics include groups, subgroups, cyclic groups, groups of permutations, homomorphisms, isomorphisms, the order of group elements, cosets, quotient structures, isomorphism theorems and an introduction to rings and fields.
Prerequisites: MATH 310.

MATH 491 Abstract Algebra II 3 Credits
A continuation of MATH 490 Abstract Algebra I. Topics include properties of rings, subrings, ideals, quotient structures; ring homomorphisms and isomorphisms, integral domains, polynomial rings, properties of fields, subfields, field extensions, finite fields and Galois Theory.
Prerequisites: MATH 490.

MATH 492 Senior Capstone 3 Credits
Exploration and communication of mathematical ideas and problems relevant to individual mathematics concentrations by integrating and extending material covered in mathematics coursework. Investigations may also include placing mathematics in historical, applied, professional and social contexts.
Prerequisites: Senior standing.
Terms Typically Offered: Fall.

MATH 494 Senior Seminar II 2 Credits
Capstone course, with discussion of specialized topics and analysis of mathematical results, requiring students to interpret and present research. Subject matter will vary. Presentations and/or written research papers will be required.
Prerequisites: Permission of instructor.

MATH 495 Independent Study 1-3 Credits
Course may be taken multiple times up to maximum of 6 credit hours.

MATH 496 Topics 1-3 Credits
Course may be taken multiple times up to maximum of 15 credit hours.

MATH 500 Introduction to Graduate Studies in Applied Mathematics 3 Credits
Introduction to methods and concepts of applied mathematics, including differentiation and integration of single and multivariate functions, vector calculus methods, matrix-vector computations, vector space concepts, and mathematical proofs.
Prerequisites: Acceptance into the Graduate Certificate in Applied Mathematics program.

MATH 510 Applied Probability and Statistics 3 Credits
Develop a comprehension of, and an ability to perform, statistical methods that are most common in educational research. Emphases on statistical concepts that will further prepare teachers to teach introductory-level college statistics and critically examine and comprehend the data analysis in educational literature. Graphing calculators and computer software may be used to analyze and display data.
Prerequisites: Acceptance into the Graduate Certificate in Applied Mathematics program.

MATH 520 Applied Numerical Methods 3 Credits
Investigation of fundamental algorithms and analysis of numerical methods commonly used by scientists, engineers, and mathematicians to approximately solve mathematical problems that are analytically impossible or intractable.
Prerequisites: MATH 500.

MATH 530 Applied Mathematical Modeling 3 Credits
Investigation of applications of mathematics in the natural and social sciences, involving continuous, discrete, and probabilistic models. Survey of historical applications of mathematics in fields including chemistry, engineering, finance, ecology, and management; and creation of new models to address current questions in these fields. Involves model creation and model selection, analytical and computational methods of solving a model, and presentation of original work in a seminar setting.
Prerequisites: MATH 500.

MATH 540 Applied Audio and Image Processing 3 Credits
Investigation of the mathematics behind the processing of sound waves and digital images. Both theory and computer-based applications will be explored, using methods of calculus, matrix-vector algebra, and inner product spaces.
Prerequisites: MATH 500.

MATH 550 Mathematical Logic and Foundations in Mathematics 3 Credits
Study of logical systems, formal languages, satisfaction, deduction, correctness, completeness, applications to algebraic structures and orderings, construction of ordinal and cardinal numbers within axiomatic set theory, models of computation, undecidability, computational complexity, intractability, and introduction to themes within the philosophy of mathematics.
Prerequisites: Acceptance into the Graduate Certificate in Applied Mathematics program.

MATH 560 Applied Number Theory 3 Credits
Applied treatment of number theory including prime numbers, congruences, quadratic residues and primitive roots.
Prerequisites: Acceptance into the Graduate Certificate in Applied Mathematics program.

MATH 570 Applied Cryptography 3 Credits
Exploration of cryptography. Topics include number theory, classical ciphers, integer factorization, primality testing, public-key ciphers, digital signatures schemes, commitment schemes, elliptic curve methods, and applications to e-commerce. Additional topics upon student interest.
Prerequisites: MATH 560.

MATH 596 Topics 1-3 Credits
Course may be taken multiple times up to maximum of 15 credit hours.