

# Mathematics

## SUPPORT

*Note that credit earned for support courses does not count toward unit requirements for graduation, GE, or major.*

**MATH 1. Support for College Algebra** (1). Integrated support for development of quantitative reasoning in College Algebra. [Coreq: MATH 101i.]

**MATH 3. Support for Mathematics as a Liberal Art** (1). Integrated support for development of quantitative reasoning Mathematics as a Liberal Art. [Coreq: MATH 103i.]

**MATH 4. Support for Finite Mathematics** (1). Integrated support for development of quantitative reasoning in Finite Mathematics. [Coreq: MATH 104i.]

**MATH 99. Supplementary Instruction in Mathematics** (2). For students needing help in mathematics courses. Enroll concurrently in supported class. [CR/NC.]

## LOWER DIVISION

*Prerequisites: Most mathematics courses have prerequisites. Thus, to be eligible to enroll in a mathematics course, a student must have received a grade of C- or higher in the HSU courses listed as prerequisites. In some lower division courses, a student may also satisfy the prerequisites by having an appropriate placement category or taking an HSU mathematics placement exam.*

**MATH 101. College Algebra** (3). Topics include algebraic equations and inequalities; polynomial, rational, algebraic, exponential, and logarithmic functions; compositions and inverses; geometric transformations and properties of functions; difference quotients. [Prereq: Math placement category I, II or III. B-LD.]

**MATH 101i. College Algebra with Integrated Support** (3). Algebraic equations and inequalities; polynomial, rational, algebraic, exponential, and logarithmic functions; compositions and inverses; geometric transformations and properties of functions; difference quotients. [Open to students in Math placement category III or IV. Coreq: MATH 1. B-LD.]

**MATH 101T. Trigonometry** (3). Trigonometric functions, their graphs, inverses and applications, radian measure, solving triangles, trigonometric identities and equations, laws of sines and cosines, polar coordinates, vectors. [Prereq: MATH 101 or MATH 101i or equivalent. B-LD.]

**MATH 102. Algebra & Elementary Functions** (4). In-depth treatment of exponential, logarithmic, trigonometric, and polynomial functions. [Prereq: Math placement category I, II or III. Rec: take three or more years of high school mathematics including Algebra II. B-LD.]

**MATH 103. Mathematics as a Liberal Art** (3). Development of quantitative reasoning through ways mathematics uses quantitative, geometrical, algebraic, and statistical thinking in problem solving. [Prereq: Math placement category I, II or III. B-LD.]

**MATH 103i. Mathematics as a Liberal Art with Integrated Support** (3). Integrated support for development of quantitative reasoning through ways mathematics uses quantitative, geometrical, algebraic and statistical thinking in problem solving. [Open to students in Math placement category III or IV. Coreq: MATH 3. B-LD.]

**MATH 104. Finite Mathematics** (3). Topics include linear models, systems of linear equations, linear programming with two variables, financial mathematics, sets, basic probability and an introduction to descriptive statistics. [Prereq: Math placement category I, II or III. B-LD.]

**MATH 104i. Finite Mathematics with Integrated Support** (3). Integrated support for development of quantitative reasoning through business-relevant topics including linear models, systems of linear equations, linear programming, financial mathematics, sets, basic probability and descriptive statistics. [Open to students in Math placement category III or IV. Coreq: MATH 4. B-LD.]

**MATH 105. Calculus for the Biological Sciences & Natural Resources** (3). Differential and integral calculus. Apply to biological sciences, including exponential growth and decay. [Prereq: [MATH 101 and MATH 101T) or MATH 102. B-LD.]

**MATH 108. Critical Thinking in Mathematics** (3). Develop and apply critical thinking and problem-solving skills by exploring patterns and mathematical themes in school and society. Intended primarily for prospective preschool and elementary teachers. [Prereq: Math placement category I or II. B-LD.]

**MATH 109. Calculus I** (4). Limits, continuity, derivatives, integrals, and their applications. [Prereq: MATH 101T or MATH 102. B-LD.]

**MATH 110. Calculus II** (4). Logarithmic and exponential functions, inverse trigonometric functions, techniques of integration, infinite sequences and series, conic sections, polar coordinates. [Prereq: MATH 109 or completed Calculus I.]

**MATH 198. Supplemental Instruction** (1). Collaborative work for students enrolled in mathematics. [Coreq: MATH 102. CR/NC. Rep.]

**MATH 210. Calculus III** (4). Vectors; parametric equations; 3-dimensional analytic geometry; vector-valued functions; partial derivatives; multiple integrals; introduction to line integrals. [Prereq: MATH 110.]

**MATH 215. Multivariate Calculus for the Biological Sciences & Natural Resources** (3). Differential equations, partial derivatives, double integrals, and curve fitting techniques; vectors; applications. [Prereq: MATH 105 or completed Calculus I, or IA.]

**MATH 240. Introduction to Mathematical Thought** (3). Mathematical reasoning, writing, and proofs; sets, functions, topics in discrete mathematics, problem formulation, problem solving. [Prereq: MATH 110.]

**MATH 241. Elements of Linear Algebra** (3). Linear systems, matrices, determinants, linear independence, bases, eigenvalues, and eigenvectors. [Prereq: MATH 210 (C) or MATH 215.]

**MATH 253. Discrete Mathematics** (3). Sets, functions, relations, algorithms, induction, recursion, combinatorics, graphs, trees, and propositional logic. [Prereq: MATH 101T (C), or MATH 102 and CS 111.]

**MATH 280. Selected Topics in Mathematics** (.5-3). [Prereq: IA. Rep.]

## UPPER DIVISION

**MATH 301. Mathematics & Culture: Historical Perspective** (3). Various cultures' influence on development of mathematics. "Pythagorean" theorem before/after Pythagoras; history of pi from biblical to modern times; primes and perfect numbers from Euclid to today; evolution of algebra from Omar Khayyam to Renaissance and beyond. Meets history requirement for math secondary education, but for math majors does not count toward 26 units of 300-level (or above) courses. [Prereq: MATH 101T or MATH 102. DCG-n. B-UD.]

**MATH 308B - MATH 308C. Mathematics for Elementary Education** (3-3). Develop advanced perspective of concepts, structures, and algorithms of math constituting the core of K-8 math curriculum: the real number system; number theory; algebra and functions; geometry and measurement; probability and statistics; mathematical reasoning. Take in B-C order. Does not apply toward math major/minor. [Prereq: completed lower division GE math or higher, and MATH 308B (for 308C). Prior IA required for majors other than LSCD, LSEE, or CDEE. B-UD.]

**MATH 311. Vector Calculus** (2). Vector fields; line and surface integrals; Green's theorem, divergence theorem, Stokes' theorem; applications. [Prereq: MATH 210 and MATH 241.]

**MATH 313. Ordinary Differential Equations** (4). Systems and series solution methods; applications. Numerical and analytical techniques. [Prereq: MATH 210 and MATH 241.]

**MATH 314. Partial Differential Equations** (3). Fourier series; partial differential equations, boundary-value problems, applications. [Prereq: MATH 313. Rec: MATH 311.]

**MATH 315. Advanced Calculus** (4). Theory and applications of differential and integral calculus for vectors and several variables. Taylor's theorem and implicit function theorem. Transformations and mappings; line and surface integrals; integral theorems. [Prereq: MATH 210 and MATH 241.]

**MATH 316. Real Analysis I** (4). Real numbers, sequences, convergence, supremum and infimum, continuity, uniform continuity, integration, differentiation, Taylor's Theorem. [Prereq: MATH 210 and MATH 240. Strongly rec: MATH 343.]

**MATH 340. Number Theory** (3). Divisibility, congruencies, quadratic reciprocity, arithmetic functions, Diophantine equations, introduction to algebraic number theory, computer applications. [Prereq: MATH 240 and MATH 241 and CS 111.]

**MATH 343. Introduction to Algebraic Structures** (4). Elementary number theory, integral domains, groups, rings, modules, fields, linear algebras. [Prereq: MATH 240 and MATH 241.]

**MATH 344. Linear Algebra** (3). Matrices, vector spaces, linear transformations, canonical forms, characteristic values, applications. [Prereq: MATH 240 and MATH 241.]

**MATH 351. Introduction to Numerical Analysis** (4). Error analysis, computer arithmetic; solving equations in one variable; interpolation and polynomial approximation; numerical differentiation and integration; ordinary differential equations; solutions of linear systems. [Prereq: (MATH 210 or MATH 215) and MATH 241 and CS 111. Weekly: 3 hrs lect, 2 hrs lab.]

**MATH 361. Introduction to Mathematical Modeling** (4). Modeling techniques. Examples from biological, environmental, and physical sciences: continuous, discrete, stochastic, and computer simulation models. [Prereq: year of calculus and course in computer programming. Rec: course in linear algebra. Weekly: 3 hrs lect, 2 hrs lab.]

**MATH 370. School Mathematics from Advanced Viewpoint I** (3). In-depth study of real and complex numbers, functions, equations, polynomials, and trigonometry. Material is rooted in the mathematical content and problems of high school mathematics, but concepts are treated from a mathematically-advanced standpoint. [Prereq: MATH 110 and MATH 240.]

**MATH 371. Geometry** (3). Classical and modern problems and concepts. Topics from: plane and solid geometry; Euclidean geometry; deductive approaches, non-Euclidean and alternative characterizations of geometry using synthetic, analytic, and transformational approaches. [Prereq: high school geometry or equivalent, and MATH 240; or IA.]

**MATH 381. Tutorial on Mathematical Proofs** (1). Develop ability to present clear mathematical exposition and argument. [Concurrent enrollment in an upper division theoretical mathematics course. CR/NC.]

**MATH 401. History of Mathematics I** (3). Key mathematical ideas/milestones: from antiquity to evolution of calculus. Research techniques introduced. [Prereq: MATH 210 or MATH 215, and high school geometry or equivalent; or IA. Offered alternate years.]

**MATH 413. Advanced Ordinary Differential Equations** (3). Existence and uniqueness of solutions; linear systems and vector-matrix differential equations; oscillation and comparison theorems; nonlinear differential equations and stability. [Prereq: MATH 313 or equivalent. Offered alternate years.]

**MATH 416. Real Analysis II** (3). Sequences and series of functions, uniform convergence, power series, metric spaces. [Prereq: MATH 316. Strongly rec: MATH 343. Offered alternate years.]

**MATH 418. Introduction to Complex Analysis** (3). Analytic and meromorphic functions, power series, singularities, and residues. [Prereq: MATH 210 and MATH 240. Offered alternate years.]

**MATH 443. Advanced Algebraic Structures** (3). Advanced topics in groups, rings, and fields; polynomials and Galois theory; applications. [Prereq: MATH 343. Offered alternate years.]

**MATH 461. Applied Mathematical Practicum** (4). Practical experience constructing and analyzing mathematical, statistical and computational models for problems from industry, government or business. Information on mathematical careers in industry, government or business. [Prereq: 8 units of upper division mathematics courses or PHYX 340 or ENGR 322 or IA. Rec: Mathematics major; junior or senior standing.]

**MATH 470. School Mathematics from an Advanced Viewpoint II** (3). Connect undergraduate mathematics to the math curriculum of grades 7-14. Integrated projects: algebra, geometry, probability and statistics, discrete math, number theory, history of mathematics, applications of mathematics, and classical problems. Specific mix of topics depends on student background. [Prereq: senior mathematics major and IA.]

**MATH 474. Graph Theory** (3). Finite graphs, trees, digraphs, Eulerian and Hamiltonian graphs, mappings, graphs as models, coloring problems, and application of graph theory. [Prereq: MATH 240 or MATH 253 or IA. Offered alternate years.]

**MATH 480. Selected Topics in Mathematics** (1-4). [Prereq: IA. Rep.]

**MATH 481. Workshop in Tutoring Mathematics** (1). Teaching techniques applicable to a tutorial setting. Primarily for students concurrently tutoring math. [CR/NC. May count for credit only toward a major in mathematics (education). Prereq: IA. Rep twice.]

**MATH 485. Seminar in Mathematics** (1-2). Current literature, research, problem solving. [Prereq: IA. Rep. No more than two units may apply to the major. CR/NC.]

**MATH 499. Directed Study** (.5-3). Directed reading and conferences on special topics. [Rep by topic; multiple enrollments in term.]

## GRADUATE

**MATH 521. Applied Stochastic Processes** (3). Markov processes, Kolmogorov forward and backward equations, queuing theory, birth and death processes, diffusion processes, renewal theory; Brownian motion. [Prereq: MATH 313 or MATH 344 or STAT 323.]

**MATH 561. Dynamic Systems** (4). Linear and nonlinear systems of difference equations and differential equations as applied to mathematical models of real dynamic phenomena; bifurcation theory. [Prereq: MATH 313 and MATH 344.]

**MATH 562. Model Fitting** (4). Contemporary approaches to fitting descriptive and mechanistic models to data. Topics include likelihoods, parameter estimation, information-theoretic criteria, time series, and numerical methods. [Prereq: MATH 313 and STAT 323, or IA.]

**MATH 580. Selected Topics in Mathematics** (1-4). [Prereq: IA. Rep.]

**MATH 595. Mathematical Modeling Practicum** (3). Practical experience constructing and analyzing mathematical models. [Coreq: MATH 561 or IA. Rep.]

**MATH 685. Seminar in Mathematics** (1-2). Review and report on current literature and problems. [Rep.]

**MATH 690. Thesis/Project** (1-4). Guided investigation of a problem of mathematical significance, culminating in a formal report in compliance with HSU standards. [Prereq: IA. Rep.]

**MATH 695. Directed Research** (1-2). Individual research on advanced problems. [Prereq: grad standing. [Rep.]

**MATH 699. Independent Study** (.5-3). Directed reading and conferences on special topics. [Rep.]

## CREDENTIAL/LICENSURE

**MATH 700. In-Service Professional Development in Mathematics** (.5-3). Directed studies for professionals in mathematics desiring advanced or specialized instruction, especially that leading to credentialing and certification. [Prereq: IA. CR/NC. Rep.]

**MATH 701. In-Service Professional Development in Mathematics Education** (.5-5). Directed studies for professionals in mathematics desiring advanced or specialized instruction in curricular or pedagogical areas of K-16 mathematics. [Prereq: IA. Rep.]

**MATH 707. Elementary Mathematics from an Advanced Viewpoint** (1-3). Topics of interest to high school teachers: algebra, geometry, probability and statistics, number theory, history of mathematics, applications of mathematics, classical problems. Topics depend on student backgrounds. [Prereq: IA. Rep.]