MATHEMATICS (MATH)

A list of this subject's infrequently taught courses can be found on the Registrar's webpages.

MATH 105 INTERMEDIATE ALGEBRA (3 credits)
Number systems and their properties, solving linear and quadratic equations, solving systems of equations, polynomials and factoring, graphing linear and quadratic equations, graphing inequalities, exponents and radicals, operations on rational functions. Should not be needed by students with high school algebra II. OFFERED THROUGH ONLINE AND CONTINUING EDUCATION (OCE) ONLY.
Prerequisites: High school algebra I and geometry, or equivalent.

MATH 125 INTRODUCTION TO VOTING THEORY (4 credits)
Study of voting and elections from a mathematical perspective; examination of preferential voting systems with focus on axioms of fairness; weighted voting systems and indices of power; methods of apportionment, paradoxes, and the Electoral College.
Prerequisites: High school algebra I and geometry, or equivalent.
Typically offered: Fall Semester, Odd Years
(QUANTITATIVE REASONING)

MATH 135 MATHEMATICS FOR ELEMENTARY TEACHER I (4 credits)
The mathematics of the elementary school. Problem solving, sets and logic, number and numeration systems, whole number operations and their properties, patterns among natural numbers, the art of guessing, fractions, decimals, ratios and portions, integers, rational and irrational numbers, and the use of calculators.
Prerequisites: MATH 105 or equivalent.
(QUANTITATIVE REASONING)

MATH 136 MATH FOR ELEMENTARY TEACHERS II (4 credits)
A continuation of 135. Collection and treatment of data, concepts of probability, measurement, spatial concepts including one-, two- and three-dimensional shapes, congruence, similarity, and transformations inclusive of integrated classroom technology.
Prerequisites: MATH 135 or instructor consent.

MATH 140 INTRODUCTION TO STATISTICS (3 credits)
An introduction to probability and statistics including methods of summarizing and describing data, basics of probability, distribution of random variables and probability distributions including the normal curve, inferential statistics including hypothesis testing and decision making, linear regression and correlation. Additional topics may include chi-square analysis and analysis of variance.
Prerequisites: MATH 105 or high school algebra I and II and geometry, or equivalent.
(QUANTITATIVE REASONING)

MATH 150 PRECALCULUS (5 credits)
Topics in algebra and trigonometry beyond those covered in the second course in high school algebra. Emphasis on concepts, structures and technical competence. Solutions of algebraic equations and inequalities; functions and graphs; exponential, logarithmic, and trigonometric functions; elementary plane analytic geometry.
Prerequisites: MATH 105 or high school algebra I and II and geometry, or equivalent.

MATH 160 FINITE MATHEMATICS WITH CALCULUS (5 credits)
Review of algebra including equations, inequalities, functions, graphs, logarithms and exponentials. Topics in finite mathematics including matrix algebra and linear programming. Introduction to differential calculus and use in optimization. Applications in business, economics and the social sciences.
Prerequisites: MATH 105 or equivalent.

MATH 161 INTRODUCTION TO FINITE MATHEMATICS (2 credits)
Review of algebra including linear and quadratic equations, inequalites, functions, graphs. Applications in business, economics, and the social and behavioral sciences. OFFERED THROUGH ONLINE AND CONTINUING EDUCATION (OCE) ONLY.
Prerequisites: MATH 105 or consent of instructor.

MATH 162 FINITE MATHEMATICS AND CALCULUS (3 credits)
A continuation of 161, including logarithmic and exponential functions, and topics in finite mathematics including matrix algebra and linear programming. An introduction to differential calculus and its use in optimization. Applications in business, economics and the social and behavioral sciences. Completion of both 161 and 162 is the equivalent of 160. OFFERED THROUGH ONLINE AND CONTINUING EDUCATION (OCE) ONLY.
Prerequisites: MATH 161 or consent of instructor.

MATH 170 CALCULUS I (5 credits)
Differential and integral calculus of real functions of one variable. Differentiation, the chain rule, the mean-value theorem, the fundamental theorem, limits and continuity, curve sketching. Integration by substitution. Application of the derivative and integral to physics and geometry.
Prerequisites: MATH 150 or equivalent.

MATH 175 CALCULUS II (3 credits)
A continuation of Calculus I to include further techniques of integration, Taylor approximations, sequences and series. Plane analytic geometry, parametric equations, including polar form.
Prerequisites: MATH 170 or equivalent with a grade of C- or better.

MATH 198 SPECIAL TOPICS: JAN TERM TRAVEL (4 credits)
Topics vary according to faculty availability and interest. Past topics have included Traversing the Eulerian Trail, and Capital Ideas: Mathematics and Culture in Dynastic China and Japan. Offered only as student interest and university resources permit. May be repeated for credit with different topics.
Prerequisites: IDST 098 previous fall.
Typically offered: January Term

MATH 200 VECTOR CALCULUS (5 credits)
Functions of several variables; differentiability and continuity; arc length and differential geometry; Taylor's formula; extrema and Lagrange multipliers; multiple integration, line and surface integrals; the theorems of Green, Gauss and Stokes.
Prerequisites: MATH 175 or equivalent.

MATH 210 ORDINARY DIFFERENTIAL EQUATIONS (4 credits)
First-order equations, including separation of variables and integrating factors; second-order linear equations, including nonhomogeneous techniques, Laplace transforms and power series methods; linear systems, including eigenvalue methods and matrix exponentials; applications to mechanics, physics, chemistry, biology and economics.
Prerequisites: MATH 175 or equivalent.
Typically offered: Spring Semester
(QUANTITATIVE REASONING)

MATH 220 INTRODUCTION TO PROOFS (3 credits)
Fundamental concepts in abstract mathematics with an emphasis
on learning to write mathematical proofs. Topics include logic, sets,
relations, functions, proof by contradiction, proof by contrapositive, and
mathematical induction.
Prerequisites: MATH 170 or equivalent with a grade of C- or better.
Typically offered: January Term

MATH 230 DISCRETE MATHEMATICS (4 credits)
Topics in the general area of discrete mathematical structures including
sets, logic, relations, functions, induction, matrices, basic enumeration,
graphs, and Boolean algebra.
Prerequisites: MATH 170 or equivalent with a grade of C- or better.
Typically offered: Fall Semester

MATH 250 LINEAR ALGEBRA (4 credits)
Matrix theory and linear algebra, including linear transformations and
their matrices, systems of linear equations, determinants, eigenvalues,
vector spaces, orthogonal matrices and bases, and reduced and
canonical forms. Applications may include image compression,
dynamical systems, stochastic matrices and Markov chains.
Prerequisites: MATH 170 or equivalent with a grade of C- or better.

MATH 280 MATHEMATICAL MODELING EXPERIENCE (1 credit)
Participation in the Mathematical Contest in Modeling sponsored by the
Consortium for Mathematics and its Applications. Experience solving real
world problems using mathematical methods. Formal presentation of
project results. May be repeated for credit.
Prerequisites: Consent of instructor.
Typically offered: Spring Semester

MATH 290 HISTORY OF MATHEMATICS (3 credits)
Topics in the development of mathematics from ancient times to present.
Prerequisites: MATH 175 and INQS 125 or instructor consent.
Typically offered: Spring Semester, Even Years

MATH 298 SPECIAL TOPICS: JAN TERM TRAVEL (4 credits)
Topics vary according to faculty availability and interest. Past topics have
included Traversing the Eulerian Trail, and Capital Ideas: Mathematics
and Culture in Dynastic China and Japan. Offered only as student interest
and university resources permit. May be repeated for credit with different
topics.
Prerequisites: IDST 098 previous fall.
Typically offered: January Term

MATH 310 NONLINEAR ODE'S & DYNAMIC SYSTEMS (3 credits)
Nonlinear differential equations from a dynamical systems approach.
Scalar autonomous equations; elementary bifurcations; linear systems
and canonical forms; planar autonomous systems; stability near
equilibria including Liapunov functions; periodic orbits and the Poincare-
Bendixson theorem; Lorenz equations, chaos and strange attractors; one-
dimensional maps including the logistical map.
Prerequisites: MATH 200 and MATH 210 or instructor consent.
Typically offered: Fall Semester, Even Years
(QUANTITATIVE REASONING)

MATH 320 HIGHER GEOMETRY (4 credits)
Modern exploration of geometries as the study of objects and functions
that remain unchanged under allowable transformations. Mobius
transformations and their properties; Euclidean, elliptic, and hyperbolic
geometries; the geometry and topology of surfaces, including the Gauss-
Bonnet Theorem; 3-manifolds and the shape of the universe; connections
to topology and group theory will be made, though no background from
those areas will be required for this class.
Prerequisites: MATH 175 and at least one of MATH 220, MATH 230, or
MATH 250
Typically offered: Fall Semester, Even Years

MATH 330 COMBINATORICS (3 credits)
Combinatorical theory with focus on techniques of enumeration. Topics
include generating functions, recurrence relations, inclusion-exclusion,
pigeonhole principle. Advanced topics selected from posets, lattices,
Polya counting, difference sequences, Stirling numbers, and Catalan
numbers.
Prerequisites: MATH 175 and at least one of MATH 220, MATH 230, or
MATH 250.
Typically offered: Spring Semester, Odd Years

MATH 340 PROBABILITY AND STATISTICS I (4 credits)
Discrete and continuous random variables; descriptive statistics of
a single random variable; the Central Limit Theorem; applications of
confidence intervals and hypothesis testing; linear regression.
Prerequisites: MATH 175.
Typically offered: Fall Semester
(QUANTITATIVE REASONING)

MATH 350 NUMBER THEORY (3 credits)
Properties of the integers. Divisibility, prime numbers, congruence.
Chinese Remainder Theorem, Wilson's Theorem, Euler's Theorem.
Emphasis on writing proofs in the context of number theory;
mathematical induction.
Prerequisites: MATH 220, MATH 230, or MATH 250.
Typically offered: Fall Semester, Even Years

MATH 365 GAME THEORY (3 credits)
The mathematics of economic game theory. Two-person matrix games
and their solutions. The Minimax Theorem, linear programming and
the simplex method, Nash equilibria. Topics from non-cooperative and
cooperative game theory.
Prerequisites: MATH 175 and MATH 250.
Typically offered: Spring Semester, Odd Years
(QUANTITATIVE REASONING)

MATH 370 ELEMENTARY ANALYSIS (4 credits)
Fundamental proof-writing techniques emphasizing analysis of real-
valued functions; sequences including Cauchy sequences; limits and
continuity including uniform continuity; differentiation, the mean value
theorem and Taylor's Theorem; the Riemann integral and the fundamental
theorem of calculus.
Prerequisites: MATH 175. MATH 220 or MATH 230 recommended.
Typically offered: Fall Semester, Annually

MATH 380 NUMERICAL ANALYSIS (4 credits)
Numerical analysis involving mathematical and statistical methods, use
of interactive mathematical software to solve such problems. Topics
include: numerical solution of non-linear equations, numerical solution
of systems of equations, numerical differentiation and integration,
numerical solution of ordinary differential equations, interpolation, curve
fitting, analysis of errors.
Prerequisites: MATH 200. MATH 250 (may be taken concurrently).
Typically offered: Spring Semester, Odd Years

MATH 398 SPECIAL TOPICS: JAN TERM TRAVEL (4 credits)

Topics vary according to faculty availability and interest. Past topics have included Traversing the Eulerian Trail, and Capital Ideas: Mathematics and Culture in Dynastic China and Japan. Offered only as student interest and university resources permit. May be repeated for credit with different topics.

Prerequisites: IDST 098 previous fall.

Typically offered: January Term

MATH 400 TOPICS IN MATHEMATICS (1-5 credits)

Selected topics not regularly offered at Linfield.

MATH 410 PARTIAL DIFFERENTIAL EQUATIONS (3 credits)

Fourier series and the methods of separation of variables; Sturm-Liouville problems; Green's functions; the method of characteristics; Laplace, heat and wave equations, and selected applications.

Prerequisites: MATH 200 and MATH 210.

Typically offered: Fall Semester, Odd Years

MATH 420 TOPOLOGY (3 credits)

Basic topics in point set topology. Product, quotient and subspace topologies; metric spaces; closed sets and limit points; connectedness; compactness; the separation axioms; introduction to fundamental group and covering spaces.

Prerequisites: MATH 200 and at least one of MATH 220, MATH 230, or MATH 250. MATH 370 strongly recommended.

Typically offered: Fall Semester, Odd Years

MATH 430 GRAPH THEORY (3 credits)

Topics in graph theory including trees, bipartite graphs, Eulerian and Hamiltonian graphs, matchings, connectivity, coloring, planar graphs. Advanced topics selected from Ramsey theory, pebbling, competitive coloring, and matroids.

Prerequisites: MATH 220, MATH 230, or MATH 250.

Typically offered: Spring Semester, Even Years

MATH 440 PROBABILITY & STATISTICS II (3 credits)

Multivariate probability distributions; functions of random variables; point estimators; maximum likelihood estimators; theory of hypothesis testing and power; method of least squares.

Prerequisites: MATH 200 and MATH 340.

Typically offered: Spring Semester, Even Years

MATH 450 ABSTRACT ALGEBRA (4 credits)

Basic algebraic structures; groups, rings, and fields. Cosets, normal subgroups, factor groups, ideals, factor rings, polynomial rings. Homomorphisms and isomorphisms.

Prerequisites: MATH 220, MATH 230, or MATH 250.

Typically offered: Spring Semester, Odd Years

MATH 460 COMPLEX ANALYSIS (4 credits)

Complex numbers and functions; the complex derivative; complex integration; Taylor and Laurent series; residue theory; conformal mapping. Selected applications.

Prerequisites: MATH 200 and MATH 370.

Typically offered: Spring Semester, Odd Years

MATH 470 REAL ANALYSIS (4 credits)

Infinite Series of Real Numbers; Infinite Series of Functions including Power Series and Analytic Functions; Topology of Euclidean Spaces; Differentiability on R^n; Riemann Integration on R^n; Measurable sets and functions; Introduction to Lebesgue integration and convergence theorems.

Prerequisites: MATH 200, MATH 250 and MATH 370.

Typically offered: Spring Semester, Even Years

MATH 480 INDEPENDENT STUDY (1-5 credits)

Study of selected topics under an instructor's guidance. For advanced mathematics majors with a high degree of self-reliance. Periodic written and oral reports and, in most cases, a comprehensive final paper.

MATH 485 SENIOR SEMINAR (3 credits)

Department capstone course. Examination of the nature of mathematics and its role within the liberal arts. Focus on reading current mathematics, writing a survey article, and presenting results. (Listed as DATA 485 and MATH 485)

Prerequisites: MATH 370 and senior standing, or consent of instructor.

Typically offered: Spring Semester

(MAJOR WRITING INTENSIVE)

MATH 498 SPECIAL TOPICS: JAN TERM TRAVEL (4 credits)

Topics vary according to faculty availability and interest. Past topics have included Traversing the Eulerian Trail, and Capital Ideas: Mathematics and Culture in Dynastic China and Japan. Offered only as student interest and university resources permit. May be repeated for credit with different topics.

Prerequisites: IDST 098 previous fall.

Typically offered: January Term