**MATHEMATICS (MATH)**

**MATH F113X  Numbers and Society**  (m)
3 Credits
Numbers and data help us understand our society. In this course, we develop mathematical concepts and tools to understand what numbers and data can tell us. Topics may include the mathematics of elections and voting, modeling population growth, financial mathematics, polls and surveying, and introductory probability and descriptive statistics. Note: This course may be taken independently from Math F114X, and both courses can be taken for credit in either order.

**Prerequisites:** An appropriate score on the math placement test, or DEVM F105, DEVF105N, or DEV F105J.

**Attributes:** UAF GER Mathematics Req

**Lecture + Lab + Other:** 3 + 0 + 0

**MATH F114X  Patterns and Society**  (m)
3 Credits
Patterns are present in every aspect of daily life. In this course, we develop mathematical concepts and tools to understand what patterns can tell us. Topics may include dividing things fairly; determining efficient routes and schedules; analyzing networks and their properties; the mathematics of symmetry, fractal geometry, and patterns in nature. Note: This course may be taken independently from MATH F113X, and both courses can be taken for credit in either order.

**Prerequisite:** An appropriate score on the math placement test, DEVM F105, DEVF105N or DEV F105J.

**Attributes:** UAF GER Mathematics Req

**Lecture + Lab + Other:** 3 + 0 + 0

**MATH F122X  Essential Precalculus with Applications**  (m)
3 Credits
A study of various classes of functions, exploring their numeric, algebraic and graphical aspects. Function classes include linear, quadratic, rational, exponential and logarithmic. This course is appropriate for students in programs relating to business and economics or life sciences or students intending to take MATH F230X. Note: Credit may be earned for MATH F151X or MATH F122X, but not for both.

**Prerequisites:** Appropriate placement score, DEVM F105, DEVF105N or DEV F105J. For students who have previously received a grade below C- or a W in Math F122X: MATH F122R or MATH F122S (MATH F122S must be taken concurrently).

**Attributes:** UAF GER Mathematics Req

**Lecture + Lab + Other:** 3 + 0 + 0

**MATH F151X  College Algebra for Calculus**
4 Credits
Study of linear, quadratic, rational, exponential and logarithmic. This course is appropriate for students in programs relating to business and economics or life sciences or students intending to take MATH F230X. Note: Credit may be earned for MATH F151X or MATH F151S, but not for both.

**Prerequisites:** Appropriate placement score, DEVM F105, DEVF105N or DEV F105J. For students who have previously received a grade below C- or a W in Math F122X: MATH F122R or MATH F122S (MATH F122S must be taken concurrently).

**Attributes:** UAF GER Mathematics Req

**Lecture + Lab + Other:** 3 + 0 + 0

**MATH F151S  College Algebra for Calculus Skills Workshop**
1 Credit
Directed study of topics in MATH F151X. Emphasis will be placed on problem solving and mathematical communication. Also included will be instruction on how to be successful in College Algebra for Calculus and mathematics-based courses. Note: Credit may be earned for taking MATH F151R or MATH F151S, but not for both.

**Prerequisites:** Previous W or grade below C- in MATH F151X; or placement into MATH F151X; or departmental recommendation.

**Corequisites:** MATH F151X.

**Lecture + Lab + Other:** 0.7 + 1 + 0

**MATH F152X  Trigonometry**  (m)
3 Credits
A study of trigonometric functions including graphing, identities, inverse trigonometric functions, solving equations and polar coordinates; applications. Note: Only eight credits total may be earned from MATH F151X, MATH F152X and MATH F156X.

**Prerequisites:** MATH F151X (may be taken concurrently) or placement.

**Attributes:** UAF GER Mathematics Req

**Lecture + Lab + Other:** 3 + 0 + 0
MATH F156R  Prep for Precalculus
1 Credit
An intensive, individualized review of prerequisite topics needed in
precalculus along with small group practice of related topics. Emphasis
will be placed on problem solving and mathematical communication.
Also included will be instruction on how to be successful in precalculus.
Note: Credit may be earned for taking MATH F156R or MATH F156S, but
not for both.
Prerequisites: Previous W or grade below C- in MATH F156X; or
placement into MATH F156X; or departmental recommendation.

MATH F156S  Precalculus Skills Workshop
1 Credit
Directed study of topics in precalculus. Emphasis will be placed on
problem solving and mathematical communication. Also included will
be instruction on how to be successful in precalculus and mathematics-
based courses. Note: Credit may be earned for taking MATH F156R or
MATH F156S, but not for both.
Prerequisites: Previous W or grade below C- in MATH F156X; or
placement into MATH F156X; or departmental recommendation.

MATH F156X  Precalculus (m)
4 Credits
Various classes of functions and their graphs are explored numerically,
algebraically and graphically. Function classes include polynomial,
rational, exponential, logarithmic and trigonometric. Skills and concepts
needed for calculus are emphasized. This class is intended for students
intending to take MATH F251X. Note: Only eight credits total may be
earned from MATH F151X, MATH F152X and MATH F156X.
Prerequisites: Placement into MATH F156X; For students who have
previously received a grade below C- or a W in Math F156X: MATH F156R
or MATH F156S (MATH F156S must be taken concurrently).
Attributes: UAF GER Mathematics Req

MATH F251R  Prep for Calculus
1 Credit
An intensive, individualized review of prerequisite topics needed in
Essential Calculus with Applications along with small group practice of
related topics. Emphasis will be placed on problem solving and
mathematical communication. Also included will be instruction on how
to be successful in calculus. Note: credit may be earned for taking
MATH F230R or MATH F230S, but not for both.
Prerequisites: Previous W or grade below C- in MATH F230X; or
placement into MATH F230X; or departmental recommendation.

MATH F230X  Essential Calculus with Applications
3 Credits
An introduction to the key ideas of differential and integral calculus, and
their uses in business, economics and the life sciences. This course
emphasizes a solid conceptual understanding, along with calculation
techniques for basic applications. Note: Credit cannot be earned for
both MATH F230X and MATH F251X. MATH F230X cannot serve as a
prerequisite for MATH F252X.
Prerequisites: MATH F122X; or MATH F151X; or MATH F156X; or
placement; For students who have previously received a grade below
C- or a W in MATH F230X; MATH F230R or MATH F230S (MATH F230S
must be taken concurrently).
Attributes: UAF GER Mathematics Req

MATH F230S  Essential Calculus with Applications Skills Workshop
1 Credit
Directed study of topics in MATH F230X; emphasis will be placed on
problem solving and mathematical communication. Also included will
be instruction on how to be successful in calculus and other mathematics-
based courses. Note: credit may be earned for taking MATH F230R or
MATH F230S, but not for both.
Prerequisites: Previous W or grade below C- in MATH F230X; or
placement into MATH F230X; or departmental recommendation.
Corequisites: MATH F230X.

MATH F231 Mathematics for Elementary School Teachers  (m)
3 Credits
Elementary set theory, numeration systems, and algorithms of arithmetic,
divisors, multiples, integers and introduction to rational numbers.
Emphasis on classroom methods. Restricted to Elementary Education
majors; others by permission of instructor.
Prerequisites: MATH F122X; or MATH F151X; or MATH F156X; or
placement.

MATH F232 Mathematics for Elementary School Teachers II  (m)
3 Credits
Offered Spring
A continuation of MATH F211. Real number systems and subsystems,
logic, informal geometry, metric system, probability and statistics.
Emphasis on classroom methods.
Prerequisites: MATH F211.

MATH F251S  Calculus I Skills Workshop  
1 Credit  
Directed study of topics in MATH F251X, emphasis will be placed on problem solving and mathematical communication. Also included will be instruction on how to be successful in Calculus I and mathematics-based courses. Note: Credit may not be earned for both MATH F251X and MATH F253X. 
Prerequisites: Previous W or grade below C- in MATH F251X; or placement into MATH F251X; or departmental recommendation. 
Corequisites: MATH F251X. 
Lecture + Lab + Other: 0.5 + 1.5 + 0 
MATH F251X  Calculus I (m)  
4 Credits  
A first course in single-variable calculus. Topics include limits; continuity and differentiation of functions; applications of the derivative to graphing, optimization, and rates of change; definite and indefinite integration; and the Fundamental Theorem of Calculus. Note: Credit may not be earned for both MATH F251X and MATH F253X. 
Prerequisites: Appropriate score on the math placement test; or MATH F151X and MATH F152X; or MATH F156X; For students who have previously received a grade below C- or a W in MATH F251X: MATH F251R or MATH F251S (MATH F251S must be taken concurrently). 
Corequisites: MATH F251L. 
Attributes: UAF GER Mathematics Req 
Lecture + Lab + Other: 4 + 0 + 0 
MATH F252X  Calculus II (m)  
4 Credits  
Further topics in single-variable calculus, including techniques of integration; applications of integration; convergence of sequences and series; parameterized curves; and polar coordinates. 
Prerequisites: MATH F251X. 
Attributes: UAF GER Mathematics Req 
Lecture + Lab + Other: 4 + 1 + 0 
MATH F253X  Calculus III (m)  
4 Credits  
Multivariable calculus. Topics include vectors in 2- and 3-dimensions; differential calculus of functions of several variables; multiple integration; vector calculus, including Green's and Stokes' Theorem; and applications. 
Prerequisites: MATH F252X. 
Attributes: UAF GER Mathematics Req 
Lecture + Lab + Other: 4 + 0 + 0 
MATH F265  Introduction to Mathematical Proofs (m)  
3 Credits  
Offered Spring 
Emphasis on proof techniques with topics including logic, sets, cardinality, relations, functions, equivalence, induction, number theory, congruence classes and elementary counting. In addition, a rigorous treatment of topics from calculus or a selection of additional topics from discrete mathematics may be included. 
Prerequisites: MATH F252X (may be taken concurrently). 
Lecture + Lab + Other: 3 + 0 + 0 
MATH F302  Differential Equations  
3 Credits  
Nature and origin of differential equations, first order equations and solutions, linear differential equations with constant coefficients, systems of equations, power series solutions, operational methods, and applications. 
Prerequisites: MATH F253X. 
Lecture + Lab + Other: 3 + 0 + 0
Mathematics (MATH)

MATH F321  Number Theory
3 Credits
Offered Fall Even-numbered Years
The theory of numbers is concerned with the properties of the integers, one of the most basic of mathematical sets. Seemingly naïve questions of number theory stimulated much of the development of modern mathematics and still provide rich opportunities for investigation. Topics studied include classical ones such as primality, congruences, quadratic reciprocity and Diophantine equations, as well as more recent applications to cryptography. Additional topics such as continued fractions, elliptical curves or an introduction to analytic methods may be included.
Prerequisites: MATH F265.
Lecture + Lab + Other: 3 + 0 + 0

MATH F371  Probability
3 Credits
Offered Fall Odd-numbered Years
Probability spaces, conditional probability, random variables, continuous and discrete distributions, expectation, moments, moment generating functions and characteristic functions.
Prerequisites: MATH F253X.
Lecture + Lab + Other: 3 + 0 + 0

MATH F401  Introduction to Real Analysis  (W)
3 Credits
Offered Fall
Completeness of the real numbers and its consequence, convergence of sequences and series, limits and continuity, differentiation, the Riemann integral.
Prerequisites: WRTG F111X; WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X; MATH F253X; MATH F265.
Lecture + Lab + Other: 3 + 0 + 0

MATH F404  Introduction to Topology
3 Credits
Offered Fall
Introduction to topological spaces, set theory, open sets, compactness, connectedness, product spaces, metric spaces and continua.
Prerequisites: MATH F253X; MATH F265.
Recommended: MATH F314 and/or MATH F405.
Lecture + Lab + Other: 3 + 0 + 0

MATH F405  Abstract Algebra  (W)
3 Credits
Offered Spring
Theory of groups, rings and fields.
Prerequisites: WRTG F111X; WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X; MATH F253X; MATH F265.
Recommended: MATH F307 and/or MATH F314.
Lecture + Lab + Other: 3 + 0 + 0

MATH F408  Mathematical Statistics
3 Credits
Offered Spring Even-numbered Years
Distribution of random variables and functions of random variables, interval estimation, point estimation, sufficient statistics, order statistics, and test of hypotheses including various criteria for tests.
Prerequisites: MATH F371; STAT F200X.
Lecture + Lab + Other: 3 + 0 + 0

MATH F412  Differential Geometry
3 Credits
Offered Spring Odd-numbered Years
Introduction to the differential geometry of curves, surfaces, and Riemannian manifolds. Basic concepts covered include the Frenet-Serret apparatus, surfaces, first and second fundamental forms, geodesics, Gauss curvature and the Gauss-Bonnet Theorem. Time permitting, topics such as minimal surfaces, theory of hypersurfaces and/or tensor analysis may be included.
Prerequisites: MATH F314; MATH F401.
Lecture + Lab + Other: 3 + 0 + 0

MATH F421  Applied Analysis
4 Credits
Offered Fall
Vector calculus, including gradient, divergence, and curl in orthogonal curvilinear coordinates, ordinary and partial differential equations and boundary value problems, and Fourier series and integrals.
Prerequisites: MATH F302.
Lecture + Lab + Other: 4 + 0 + 0

MATH F422  Introduction to Complex Analysis
3 Credits
Offered Spring
Complex functions including series, integrals, residues, conformal mapping and applications. May be taken independently of MATH F421.
Prerequisites: MATH F302.
Lecture + Lab + Other: 3 + 0 + 0

MATH F430  Topics in Mathematics
3 Credits
Offered Spring
An elective course in mathematics for majors. Topics will vary from year to year and may be drawn from mathematical biology, numerical linear algebra, graph theory, logic, or other areas of mathematics. May be repeated with permission of instructor for a total of nine credits.
Prerequisites: MATH F265.
Lecture + Lab + Other: 3 + 0 + 0

MATH F460  Mathematical Modeling
3 Credits
Offered Fall
Introduction to mathematical modeling using differential or difference equations. Emphasis is on formulating models and interpreting qualitative behavior such models predict. Examples will be taken from a variety of fields, depending on the interest of the instructor. Students develop a modeling project.
Prerequisites: COJO F131X or COJO F141X; WRTG F111X, WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X; MATH F252X.
Recommended: one or more of MATH F302, MATH F310, MATH F314, MATH F401, STAT F300 or some programming experience.
Lecture + Lab + Other: 3 + 0 + 0

MATH F490  Senior Seminar  (O)
2 Credits
Offered Spring
Advanced topics selected from areas outside the usual undergraduate offerings. A substantial level of mathematical maturity is assumed.
Prerequisites: COJO F131X or COJO F141X; at least one of MATH F401 or MATH F405; senior standing.
Lecture + Lab + Other: 2 + 0 + 0
MATH F600  Teaching Seminar
1 Credit
Fundamentals of teaching mathematics in a university setting. Topics may include any aspect of teaching: university regulations, class and lecture organization, testing, book selection, teaching evaluations, etc. Specific topics will vary on the basis of student and instructor interest. Individual classroom visits will also be used for class discussion. May be repeated for credit.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 1 + 0 + 0

MATH F611  Mathematical Physics I
3 Credits
Offered Fall
Mathematical tools and theory for classical and modern physics. Core topics: Linear algebra including eigenvalues, eigenvectors and inner products in finite dimensional spaces. Infinite series. Hilbert spaces and generalized functions. Complex analysis, including Laurent series and contour methods. Applications to problems arising in physics. Selected additional topics, which may include operator and spectral theory, groups, tensor fields, hypercomplex numbers.
Prerequisites: MATH F302; MATH F314; MATH F421; MATH F422.
Cross-listed with PHYS F611.
Lecture + Lab + Other: 3 + 0 + 0

MATH F612  Mathematical Physics II
3 Credits
Offered Spring
Continuation of Mathematical Physics I; mathematical tools and theory for classical and modern physics. Core topics: Linear algebra including eigenvalues, eigenvectors and inner products in finite dimensional spaces. Infinite series. Hilbert spaces and generalized functions. Complex analysis, including Laurent series and contour methods. Applications to problems arising in physics. Selected additional topics, which may include operator and spectral theory, groups, tensor fields, hypercomplex numbers.
Prerequisites: MATH F611 or MATH F611.
Cross-listed with PHYS F612.
Lecture + Lab + Other: 3 + 0 + 0

MATH F614  Numerical Linear Algebra
3 Credits
Offered Fall Odd-numbered Years
Prerequisites: MATH F314.
Recommended: MATH F421 or MATH F401.
Lecture + Lab + Other: 3 + 0 + 0

MATH F615  Numerical Analysis of Differential Equations
3 Credits
Offered Spring Odd-numbered Years
Review of numerical differentiation and integration, and the numerical solution of ordinary differential equations. Main topics to include the numerical solution of partial differential equations, curve fitting, splines, and the approximation of functions. Supplementary topics such as the numerical method of lines, the fast Fourier transform, and finite elements may be included as time permits and interest warrants.
Prerequisites: CS F201; MATH F310; MATH F314; MATH F421; MATH F422.
Lecture + Lab + Other: 3 + 0 + 0

MATH F617  Functional Analysis
3 Credits
Offered Spring Even-numbered Years
Study of Banach and Hilbert spaces, and continuous linear maps between them. Linear functionals and the Hahn-Banach theorem. Applications of the Baire Category theorem. Compact operators, self adjoint operators, and their spectral properties. Weak topology and its applications.
Prerequisites: MATH F314; MATH F401.
Recommended: MATH F422; MATH F641.
Lecture + Lab + Other: 3 + 0 + 0

MATH F631  Algebra I
4 Credits
Offered Fall Even-numbered Years
Rigorous development of groups, rings and fields.
Prerequisites: MATH F405.
Lecture + Lab + Other: 4 + 0 + 0

MATH F632  Algebra II
3 Credits
Offered Spring Odd-numbered Years
Advanced topics which may be chosen from group theory, Galois theory, commutative or non-commutative algebra, algebraic geometry, homological algebra or other areas.
Prerequisites: MATH F631.
Lecture + Lab + Other: 3 + 0 + 0

MATH F641  Real Analysis
4 Credits
Offered Spring Even-numbered Years
General theory of Lebesgue measure and Lebesgue integration on the real line. Convergence properties of the integral. Introduction to the general theory of measures and integration. Differentiation, the product measures and an introduction to LP spaces.
Prerequisites: MATH F401.
Lecture + Lab + Other: 4 + 0 + 0

MATH F645  Complex Analysis
4 Credits
Offered Spring Even-numbered Years
Prerequisites: MATH F641.
Lecture + Lab + Other: 4 + 0 + 0
MATH F651  Topology  
4 Credits  
Offered Spring Odd-numbered Years  
Treatment of the fundamental topics of point-set topology. Separation axioms, product and quotient spaces, convergence via nets and filters, compactness and compactifications, paracompactness, metrization theorems, countability properties, and connectedness. Set theory as needed for examples and proof techniques.  
Prerequisites: MATH F401 or MATH F404.  
Lecture + Lab + Other: 4 + 0 + 0

MATH F658  Topics in Geometry  
3 Credits  
Offered Fall Even-numbered Years  
Elective topics in geometry. Recent offerings include configurations of points and lines; topology and differential geometry of surfaces; polyhedra and polytopes.  
Prerequisites: Linear algebra; geometry; undergraduate real analysis; undergraduate abstract algebra.  
Lecture + Lab + Other: 3 + 0 + 0

MATH F660  Advanced Mathematical Modeling  
3 Credits  
Offered Spring Even-numbered Years  
The mathematical formulation and analysis of problems arising in the physical, biological, or social sciences. The focus area of the course may vary, but emphasis will be given to modeling assumptions, derivation of model equations, methods of analysis, and interpretation of results for the particular applications. Examples include heat conduction problems, random walk processes, molecular evolution, perturbation theory. Students will develop a modeling project as part of the course requirements.  
Prerequisites: Permission of instructor.  
Lecture + Lab + Other: 3 + 0 + 0

MATH F661  Optimization  
3 Credits  
Offered Fall Even-numbered Years  
Linear and nonlinear programming, simplex method, duality and dual simplex method, post-optimal analysis, constrained and unconstrained nonlinear programming, Kuhn-Tucker conditions. Applications to management, physical and life sciences. Computational work with the computer.  
Prerequisites: Knowledge of calculus, linear algebra and computer programming.  
Lecture + Lab + Other: 3 + 0 + 0

MATH F663  Graph Theory  
3 Credits  
Offered Fall Odd-numbered Years  
A survey of modern techniques in graph theory; topics may include graphs and digraphs, trees, spanning trees, matchings, graph connectivity, graph coloring, planarity, cycles, and extremal problems.  
Prerequisites: MATH F314; MATH F320.  
Lecture + Lab + Other: 3 + 0 + 0

MATH F665  Topics in Graduate Mathematics  
3 Credits  
Offered As Demand Warrants  
Elective courses in graduate mathematics offered by faculty on a rotating basis. Topics may include, but are not limited to, graph theory, glaciology modeling, general relativity, mathematical biology, Galois theory and numerical linear algebra. May be repeated for credit with permission of instructor.  
Lecture + Lab + Other: 3 + 0 + 0