Applied Mathematics & Statistics

Degrees Offered

- Master of Science (Applied Mathematics and Statistics)
- Doctor of Philosophy (Applied Mathematics and Statistics)

Program Description

The Department of Applied Mathematics and Statistics (AMS) at Colorado School of Mines prepares the next generation of mathematical and statistical scientists to be leaders in a world driven by increasingly complex technology and challenges. Our department is at the forefront of research in mathematical and statistical methods that are used to address the opportunities and challenges of the future. The AMS department offers two graduate degrees: A Master of Science in Applied Mathematics and Statistics and a Doctor of Philosophy in Applied Mathematics and Statistics. The master's program is designed to prepare candidates for careers in industry or government or for further study at the PhD level. The PhD program is sufficiently flexible to prepare candidates for careers in industry, government and academia. A course of study leading to the PhD degree can be designed either for students who have completed a Master of Science degree or for students with a Bachelor of Science degree.

The AMS department is also involved in the curriculum of three different interdisciplinary master's degree programs: Data Science, Operations Research with Engineering, and Quantitative Biosciences and Engineering. Please view "Interdisciplinary Programs" for more information on these programs.

Research within AMS is conducted in the following areas:

Computational and Applied Mathematics

- Deep Learning
- Differential and Integral Equations
- Dynamical Systems
- Geophysical and Environmental Applications
- High Performance Scientific Computing
- Mathematical Biology
- Meshfree Approximation Methods
- Multi-scale Analysis and Simulation
- Numerical Methods for PDEs
- Optimal Control and Transport
- Wave Phenomena and Inverse Problems

Statistics

- Geophysical and Environmental Applications
- Methods for Massive Data Sets
- Spatial and Space-Time Processes
- Functional Data Analysis
- Inverse Problems
- Uncertainty Quantification

Master of Science Program Requirements

The Master of Science degree (non-thesis option) requires 30 credits of coursework. Students pursuing the degree may count up to six credits from courses at the 400-level. For both the Computational & Applied Mathematics and Statistics specialties, the curriculum structure consists of (i) a set of required courses, (ii) a pair of MATH electives, and (iii) general elective courses that serve to supplement the student's technical interests.

Specialty in Computational & Applied Mathematics

Required Courses

MATH500	LINEAR VECTOR SPACES	3.0
MATH501	APPLIED ANALYSIS	3.0
MATH514	APPLIED MATHEMATICS I	3.0
MATH550	NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS	3.0
MATH551	COMPUTATIONAL LINEAR ALGEBRA	3.0
SYGN502	INTRODUCTION TO RESEARCH ETHICS [*]	1.0
MATH589	APPLIED MATHEMATICS AND STATISTICS TEACHING SEMINAR [**]	1.0

[*]Required only for students receiving federal support.
[**] Required only for students employed by the department as graduate teaching assistants or student instructor/lecturers.

Furthermore, students are required to complete two additional MATH courses, either at the 500-level or chosen from the following 400-level courses.

MATH Elective Courses (400-level)

MATH408	COMPUTATIONAL METHODS FOR DIFFERENTIAL EQUATIONS	3.0
MATH454	COMPLEX ANALYSIS	3.0
MATH455	PARTIAL DIFFERENTIAL EQUATIONS	3.0
MATH458	ABSTRACT ALGEBRA	3.0
MATH484	MATHEMATICAL AND COMPUTATIONAL MODELING (CAPSTONE)	4.0

Finally, the remaining nine credits come from general elective courses and may be selected from any other graduate courses offered by the Department of Applied Mathematics and Statistics, except for specially designated service courses. Alternatively, up to 6 credits of elective courses may be taken in other departments on campus to satisfy this requirement.

Specialty in Statistics

Required Courses

MATH500	LINEAR VECTOR SPACES	3.0
MATH531	THEORY OF LINEAR MODELS	3.0
MATH534	MATHEMATICAL STATISTICS I	3.0
MATH535	MATHEMATICAL STATISTICS II	3.0
MATH560	INTRODUCTION TO KEY STATISTICAL LEARNING METHODS I	3.0

MATH589	APPLIED MATHEMATICS AND STATISTICS TEACHING SEMINAR [**]	1.0
SYGN502	INTRODUCTION TO RESEARCH ETHICS [*]	1.0

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Furthermore, students are required to complete two additional MATH courses, either at the 500-level or chosen from the following 400-level courses.

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MATH454	COMPLEX ANALYSIS	3.0
MATH455	PARTIAL DIFFERENTIAL EQUATIONS	3.0
MATH458	ABSTRACT ALGEBRA	3.0
MATH484	MATHEMATICAL AND COMPUTATIONAL MODELING (CAPSTONE)	4.0

Finally, the remaining nine credits come from general elective courses and may be selected from any other graduate courses offered by the Department of Applied Mathematics and Statistics, except for specially designated service courses. Alternatively, up to 6 credits of elective courses may be taken in other departments on campus to satisfy this requirement.

The Master of Science degree (thesis option) requires 30 credits of acceptable coursework and research, completion of a satisfactory thesis, and successful oral defense of this thesis. A minimum of 6 (and a maximum of 12) of the 30 credits must be designated for supervised research, which will be in lieu of electives. The coursework includes the required core curriculum for the chosen specialty described above.

Mines Combined Undergraduate / Graduate Degree Program

Students enrolled in Mines' combined undergraduate/graduate program may double count up to six credits of graduate coursework to fulfill requirements of both their undergraduate and graduate degree programs. These courses must have been passed with "B-" or better, not be substitutes for required coursework, and meet all other University, Department, and Program requirements for graduate credit.

Students are advised to consult with their undergraduate and graduate advisors for appropriate courses to double count upon admission to the combined program.

Doctor of Philosophy Program Requirements

The Doctor of Philosophy requires 72 credits beyond the bachelor's degree. At least 24 of these hours must be thesis hours. Students pursuing the degree may count up to six credits from courses at the 400-level. Doctoral students must pass the comprehensive examination (a qualifying examination and thesis proposal), complete a satisfactory thesis, and successfully defend their thesis.

Specialty in Computational & Applied Mathematics

Required Courses

MATH500	LINEAR VECTOR SPACES	3.0
MATH501	APPLIED ANALYSIS	3.0
MATH514	APPLIED MATHEMATICS I	3.0
MATH550	NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS	3.0
MATH551	COMPUTATIONAL LINEAR ALGEBRA	3.0
SYGN502	INTRODUCTION TO RESEARCH ETHICS [*]	1.0
MATH589	APPLIED MATHEMATICS AND STATISTICS TEACHING SEMINAR [**]	1.0
MATH588	INTRODUCTION TO QUANTITATIVE AND COMPUTATIONAL RESEARCH	1.0

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Furthermore, students are required to complete two additional MATH courses, either at the 500-level or chosen from the following 400-level courses.

MATH Elective Courses (400-level)

MATH408	COMPUTATIONAL METHODS FOR DIFFERENTIAL EQUATIONS	3.0
MATH454	COMPLEX ANALYSIS	3.0
MATH455	PARTIAL DIFFERENTIAL EQUATIONS	3.0
MATH458	ABSTRACT ALGEBRA	3.0
MATH484	MATHEMATICAL AND COMPUTATIONAL MODELING (CAPSTONE)	4.0

Specialty in Statistics

Required Courses

MATH500	LINEAR VECTOR SPACES	3.0
MATH531	THEORY OF LINEAR MODELS	3.0
MATH534	MATHEMATICAL STATISTICS I	3.0
MATH535	MATHEMATICAL STATISTICS II	3.0
MATH560	INTRODUCTION TO KEY STATISTICAL LEARNING METHODS I	3.0
MATH588	INTRODUCTION TO QUANTITATIVE AND COMPUTATIONAL RESEARCH	1.0
MATH589	APPLIED MATHEMATICS AND STATISTICS TEACHING SEMINAR [**]	1.0
SYGN502	INTRODUCTION TO RESEARCH ETHICS [*]	1.0

 *Required only for students receiving federal support.
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MATH Elective Courses (400-level)

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MATH458	ABSTRACT ALGEBRA	3.0
MATH484	MATHEMATICAL AND COMPUTATIONAL MODELING (CAPSTONE)	4.0

Further information can be found on the Web at ams.mines.edu. This website provides an overview of the programs, requirements, and policies of the department.

Fields of Research:

Geophysical and Environmental Applications

Scientific Data Compression

Spatial and Space-Time Processes

Methods for Massive Data Sets

Functional Data Analysis

Inverse Problems in Statistics

Machine Learning

Uncertainty Quantification

Numerical Methods for PDEs

High Performance Scientific Computing

Biological Fluid Dynamics

Meshfree Approximation Methods

PDEs and Kinetic Theory

Computational Hydrology

Mathematical Biology including:

     Sleep and Circadian Rhythms

     Blood Coagulation

     Microorganism Motility

     Epidemiology

Courses

MATH500. LINEAR VECTOR SPACES. 3.0 Semester Hrs.
(I) Finite dimensional vector spaces and subspaces: dimension, dual bases, annihilators. Linear transformations, matrices, projections, change of basis, similarity. Determinants, eigenvalues, multiplicity. Jordan form. Inner products and inner product spaces with orthogonality and completeness. Prerequisite: MATH301, MATH332. 3 hours lecture; 3 semester hours.

MATH501. APPLIED ANALYSIS. 3.0 Semester Hrs.
(II) Fundamental theory and tools of applied analysis. Students in this course will be introduced to Banach, Hilbert, and Sobolev spaces; bounded and unbounded operators defined on such infinite dimensional spaces; and associated properties. These concepts will be applied to understand the properties of differential and integral operators occurring in mathematical models that govern various biological, physical and engineering processes. Prerequisites: MATH301 or equivalent.

MATH502. REAL AND ABSTRACT ANALYSIS. 3.0 Semester Hrs.
(I) Normed space R, open and closed sets. Lebesgue measure, measurable sets and functions. Lebesgue integral and convergence theorems. Repeated integration and integration by substitution. Lp spaces, Banach and Hilbert spaces. Weak derivatives and Sobalev spaces. Weak solutions of two-point boundary value problems. Prerequisites: MATH301 or equivalent. 3 hours lecture; 3 semester hours.

MATH503. FUNCTIONAL ANALYSIS. 3.0 Semester Hrs.
(II) Properties of metric spaces, normed spaces and Banach spaces, inner product and Hilbert spaces. Fundamental theorems for normed and Banach spaces with applications. Orthogonality and orthonormal systems on Hilbert spaces with applications to approximation theory. Compact, bounded and unbounded operators. Duality, adjoint, self-adjoint, Hilbert-adjoint operators. Spectral analysis of linear operators. Applications to differential and integral equations. Prerequisites: MATH502. 3 hours lecture; 3 semester hours.

MATH506. COMPLEX ANALYSIS II. 3.0 Semester Hrs.
(II) Analytic functions. Conformal mapping and applications. Analytic continuation. Schlicht functions. Approximation theorems in the complex domain. Taught every other year. Prerequisite: MATH454. 3 hours lecture; 3 semester hours.

MATH510. ORDINARY DIFFERENTIAL EQUATIONS AND DYNAMICAL SYSTEMS. 3.0 Semester Hrs.
(I) Topics to be covered: basic existence and uniqueness theory, systems of equations, stability, differential inequalities, Poincare-Bendixon theory, linearization. Other topics from: Hamiltonian systems, periodic and almost periodic systems, integral manifolds, Lyapunov functions, bifurcations, homoclinic points and chaos theory. Offered even years. 3 hours lecture; 3 semester hours. Prerequisite: MATH225 or MATH235 and MATH332 or MATH342 and MATH301.

MATH514. APPLIED MATHEMATICS I. 3.0 Semester Hrs.
(II) The course focuses on the application of mathematical ideas and methods for solving problems in the applied sciences and engineering. Topics include dimensional analysis, regular and singular perturbation methods, boundary layer analysis, kinetics. Other topics may include variational calculus, boundary value problems and integral equations, and discrete models. Where applicable, there will be numerical approaches to complement the analytic ones.

MATH515. APPLIED MATHEMATICS II. 3.0 Semester Hrs.
The course focuses on the application of mathematical ideas and methods for solving problems in the applied sciences and engineering. Topics include non-numerical techniques for dealing with partial differential equations, wave phenomena, continuum mechanics, conservation laws, and transform methods.

MATH530. INTRODUCTION TO STATISTICAL METHODS. 3.0 Semester Hrs.
(I,II) Review of probability, random variables, and discrete and continuous probability models. Descriptive statistics and graphical representations. General theory of Confidence intervals and hypothesis testing. Inferences for mean and variance of a single population. Inferences for means and variances for two populations. Inferences for proportions and count data.

MATH531. THEORY OF LINEAR MODELS. 3.0 Semester Hrs.
(II) Statistical framework for estimation and inference based on multiple regression, including distribution theory for sums of squares statistics and estimators. Principles of analysis of variance (ANOVA), multiple comparisons, and experimental design. Also included are some relevant topics in multivariate analysis and asymptotic, large sample theory. Prerequisites. MATH332 and MATH534.

MATH532. SPATIAL STATISTICS. 3.0 Semester Hrs.
(I) Modeling and analysis of data observed on a 2 or 3-dimensional surface. Random fields, variograms, covariances, stationarity, nonstationarity, kriging, simulation, Bayesian hierarchical models, spatial regression, SAR, CAR, QAR, and MA models, Geary/Moran indices, point processes, K-function, complete spatial randomness, homogeneous and inhomogeneous processes, marked point processes, spatio-temporal modeling. Course is offered every other year on even years. Prerequisites: MATH424 or equivalent.

MATH533. TIME SERIES AND ITS APPLICATIONS. 3.0 Semester Hrs.
Exploratory Analysis of Time Series, Stationary Time Series, Autocorrelation and Partial Autocorrelation, Autoregressive Moving Average (ARMA) Models, Forecasting, Estimation, ARIMA Models for Nonstationary Data, Multiplicative Seasonal ARIMA Models, The Spectral Density, Periodogram and Discrete Fourier Transform, Spectral Estimation, Multiple Series and Cross-Spectra, Linear Filters, Long Memory ARMA and Fractional Differencing, GARCH Models, Threshold Models, Regression with Autocorrelated Errors, Lagged Regression, Multivariate ARMAX Models. Prerequisite: MATH 324, MATH335.

MATH534. MATHEMATICAL STATISTICS I. 3.0 Semester Hrs.
(I) The basics of probability, discrete and continuous probability distributions, sampling distributions, order statistics, convergence in probability and in distribution, and basic limit theorems, including the central limit theorem, are covered. Prerequisite: none. 3 hours lecture; 3 semester hours.

MATH535. MATHEMATICAL STATISTICS II. 3.0 Semester Hrs.
(II) The basics of hypothesis testing using likelihood ratios, point and interval estimation, consistency, efficiency, sufficient statistics, and some nonparametric methods are presented. Prerequisite: MATH534 or equivalent. 3 hours lecture; 3 semester hours.

MATH536. ADVANCED STATISTICAL MODELING. 3.0 Semester Hrs.
(II) Modern extensions of the standard linear model for analyzing data. Topics include generalized linear models, generalized additive models, mixed effects models, and resampling methods. Offered every two years on odd years. 3 hours lecture; 3 semester hours. Prerequisite: MATH335, MATH424.

MATH537. MULTIVARIATE ANALYSIS. 3.0 Semester Hrs.
(I) Introduction to applied multivariate representations of data for use in data analysis. Topics include introduction to multivariate distributions; methods for data reduction, such as principal components; hierarchical and model-based clustering methods; factor analysis; canonical correlation analysis; multidimensional scaling; and multivariate hypothesis testing. Prerequisites: MATH530 and MATH332 or MATH500.

MATH538. STOCHASTIC MODELS. 3.0 Semester Hrs.
(II) An introduction to the mathematical principles of stochastic processes. Discrete- and continuous-time Markov processes, Poisson processes, Brownian motion. Offered every two years on even years. 3 hours lecture; 3 semester hours.

MATH539. SURVIVAL ANALYSIS. 3.0 Semester Hrs.
(I) Basic theory and practice of survival analysis. Topics include survival and hazard functions, censoring and truncation, parametric and non-parametric inference, the proportional hazards model, model diagnostics. Offered on odd years. Prerequisite: MATH335, MATH535. 3 hours lecture; 3 semester hours.

MATH540. PARALLEL SCIENTIFIC COMPUTING. 3.0 Semester Hrs.
This course is designed to facilitate students' learning of high-performance computing concepts and techniques to efficiently perform large-scale mathematical modelling and data analysis using modern high-performance architectures (e.g. multi-core processors, multiple processors, and/or accelerators). Emphasis will be placed on analysis and implementation of various scientific computing algorithms in high-level languages using their interfaces for parallel or accelerated computing. Use of scripting to manage HPC workflows is included. Additional emphasis will be placed on design of parallel algorithms and implementation optimization in assignments.

MATH542. SIMULATION. 3.0 Semester Hrs.
(I) Advanced study of simulation techniques, random number, and variate generation. Monte Carlo techniques, simulation languages, simulation experimental design, variance reduction, and other methods of increasing efficiency, practice on actual problems. 3 hours lecture; 3 semester hours. Prerequisite: CSCI262 (or equivalent), MATH201 (or MATH 424 or MATH530 or equivalent).

MATH544. ADVANCED COMPUTER GRAPHICS. 3.0 Semester Hrs.
Equivalent with CSCI544,
This is an advanced computer graphics course in which students will learn a variety of mathematical and algorithmic techniques that can be used to solve fundamental problems in computer graphics. Topics include global illumination, GPU programming, geometry acquisition and processing, point based graphics and non-photorealistic rendering. Students will learn about modern rendering and geometric modeling techniques by reading and discussing research papers and implementing one or more of the algorithms described in the literature.

MATH547. SCIENTIFIC VISUALIZATION. 3.0 Semester Hrs.
Equivalent with CSCI547,
Scientific visualization uses computer graphics to create visual images which aid in understanding of complex, often massive numerical representation of scientific concepts or results. The main focus of this course is on techniques applicable to spatial data such as scalar, vector and tensor fields. Topics include volume rendering, texture based methods for vector and tensor field visualization, and scalar and vector field topology. Students will learn about modern visualization techniques by reading and discussing research papers and implementing one of the algorithms described in the literature.

MATH550. NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS. 3.0 Semester Hrs.
(I) Numerical methods for solving partial differential equations. Explicit and implicit finite difference methods; stability, convergence, and consistency. Alternating direction implicit (ADI) methods. Weighted residual and finite element methods. Prerequisites: MATH225 or MATH235 and MATH332 or MATH342.

MATH551. COMPUTATIONAL LINEAR ALGEBRA. 3.0 Semester Hrs.
(II) Numerical analysis of algorithms for solving linear systems of equations, least squares methods, the symmetric eigenproblem, singular value decomposition, conjugate gradient iteration. Modification of algorithms to fit the architecture. Error analysis, existing software packages. 3 hours lecture; 3 semester hours. Prerequisite: MATH332, MATH 307.

MATH552. KERNEL-BASED APPROXIMATION METHODS. 3.0 Semester Hrs.

Positive definite kernels play an important role in many different areas of mathematics, science and engineering. We put these kernels into perspective, both historically, as well as scientifically via connections to related fields such as analysis, approximation theory, the theory of integral equations, mathematical physics, probability theory and statistics, geostatistics, statistical or machine learning, and various kinds of engineering or physics applications. None of these fields is given a thorough theoretical treatment. Instead, these topics are presented via their relation to positive definite kernels. Prerequisite: Graduate level mathematical maturity and confidence to build on elements from (computational) linear algebra, functional analysis, and Gaussian processes, such as eigenvalues, eigenfunctions, orthogonality, change of basis, Sturm-Liouville theory, Green?s kernels, maximum likelihood estimation, Bayesian statistics, and convex optimization.

MATH556. MODELING WITH SYMBOLIC SOFTWARE. 3.0 Semester Hrs.

(I) Case studies of various models from mathematics, the sciences and engineering through the use of the symbolic software package MATHEMATICA. Based on hands-on projects dealing with contemporary topics such as number theory, discrete mathematics, complex analysis, special functions, classical and quantum mechanics, relativity, dynamical systems, chaos and fractals, solitons, wavelets, chemical reactions, population dynamics, pollution models, electrical circuits, signal processing, optimization, control theory, and industrial mathematics. The course is designed for graduate students and scientists interested in modeling and using symbolic software as a programming language and a research tool. It is taught in a computer laboratory. 3 hours lecture; 3 semester hours.

MATH557. INTEGRAL EQUATIONS. 3.0 Semester Hrs.

(I) This is an introductory course on the theory and applications of integral equations. Abel, Fredholm and Volterra equations. Fredholm theory: small kernels, separable kernels, iteration, connections with linear algebra and Sturm-Liouville problems. Applications to boundary-value problems for Laplace's equation and other partial differential equations. Offered even years. Prerequisite: MATH332 or MATH342 and MATH455. 3 hours lecture; 3 semester hours.

MATH559. ASYMPTOTICS. 3.0 Semester Hrs.

Equivalent with MATH459,

(I) Exact methods for solving mathematical problems are not always available: approximate methods must be developed. Often, problems involve small parameters, and this can be exploited so as to derive approximations: these are known as asymptotic approximations. Many techniques for constructing asymptotic approximations have been devised. The course develops such approximations for algebraic problems, the evaluation of integrals, and the solutions of differential equations. Emphasis is placed on effective methods and, where possible, rigorous analysis. Prerequisites: Calculus and ordinary differential equations. 3 hours lecture; 3 semester hours.

MATH560. INTRODUCTION TO KEY STATISTICAL LEARNING METHODS I. 3.0 Semester Hrs.

(II) Part one of a two-course series introducing statistical learning methods with a focus on conceptual understanding and practical applications. Methods covered will include Introduction to Statistical Learning, Linear Regression, Cross validation, Basis Expansions, Regularization, Non linear Models, Model Assessment and Selection. Prerequisite: MATH530 or DSCI530.

MATH561. INTRODUCTION TO KEY STATISTICAL LEARNING METHODS II. 3.0 Semester Hrs.

(I) Part two of a two course series introducing statistical learning methods with a focus on conceptual understanding and practical applications. Methods covered will include Classification, Bootstrap, Tree-based Methods, Support Vector Machines, Unsupervised Learning. Prerequisite: MATH560 or DSCI560.

MATH570. MATHEMATICAL MODELING OF SPATIAL PROCESSES IN BIOLOGY. 3.0 Semester Hrs.

(II) This course is an introduction to mathematical modeling of spatial processes in biology. The emphasis is on partial differential equation models from a diverse set of biological topics such as cellular homeostasis, muscle dynamics, neural dynamics, calcium handling, epidemiology, and chemotaxis. We will survey a variety of models and analyze their results in the context of the biology. Mathematically, we will examine the diffusion equation, advection equation, and combinations of the two that include reactions. There will be a significant computational component to the course including bi-weekly computational labs; students will solve the model equations and perform computations using MATLAB. Prerequisites: MATH331 and MATH455 or equivalent courses and familiarity with MATLAB.

MATH572. MATHEMATICAL AND COMPUTATIONAL NEUROSCIENCE. 3.0 Semester Hrs.

(II) This course will focus on mathematical and computational techniques applied to neuroscience. Topics will include nonlinear dynamics, hysteresis, the cable equation, and representative models such as Wilson-Cowan, Hodgkin-Huxley, and FitzHugh-Nagumo. Applications will be motivated by student interests. In addition to building basic skills in applied math, students will gain insight into how mathematical sciences can be used to model and solve problems in neuroscience; develop a variety of strategies (computational, theoretical, etc.) with which to approach novel mathematical situations; and hone skills for communicating mathematical ideas precisely and concisely in an interdisciplinary context. In addition, the strong computational component of this course will help students to develop computer programming skills and apply appropriate technological tools to solve mathematical problems. Prerequisite: MATH331. 3 hours lecture; 3 semester hours.

MATH574. THEORY OF CRYPTOGRAPHY. 3.0 Semester Hrs.

Equivalent with CSCI574,

Students will draw upon current research results to design, implement and analyze their own computer security or other related cryptography projects. The requisite mathematical background, including relevant aspects of number theory and mathematical statistics, will be covered in lecture. Students will be expected to review current literature from prominent researchers in cryptography and to present their findings to the class. Particular focus will be given to the application of various techniques to real-life situations. The course will also cover the following aspects of cryptography: symmetric and asymmetric encryption, computational number theory, quantum encryption, RSA and discrete log systems, SHA, steganography, chaotic and pseudo-random sequences, message authentication, digital signatures, key distribution and key management, and block ciphers. Prerequisites: CSCI262 plus undergraduate-level knowledge of statistics and discrete mathematics. 3 hours lecture, 3 semester hours.

MATH582. STATISTICS PRACTICUM. 3.0 Semester Hrs.
(II) This is the capstone course in the Statistics Option. The main objective is to apply statistical knowledge and skills to a data analysis problem, which will vary by semester. Students will gain experience in problem-solving; working in a team; presentation skills (both orally and written); and thinking independently. Prerequisites: MATH 201 or 530 and MATH 424 or 531. 3 hours lecture and discussion; 3 semester hours.

MATH588. INTRODUCTION TO QUANTITATIVE AND COMPUTATIONAL RESEARCH. 1.0 Semester Hr.
Students will be expected to use applied mathematics and statistics principles to critically analyze research results in published literature and place them in the context of related literature. Skills to be developed and discussed include critical review of the literature and oral defense of these reviews.

MATH589. APPLIED MATHEMATICS AND STATISTICS TEACHING SEMINAR. 1.0 Semester Hr.
(I) An introduction to teaching issues and techniques within the AMS department. Weekly, discussion-based seminars will cover practical issues such as lesson planning, grading, and test writing. Issues specific to the AMS core courses will be included. 1 hour lecture; 1.0 semester hour.

MATH598. SPECIAL TOPICS. 6.0 Semester Hrs.
(I, II, S) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once, but no more than twice for the same course content. Prerequisite: none. Variable credit: 0 to 6 credit hours. Repeatable for credit under different titles.

MATH599. INDEPENDENT STUDY. 0.5-6 Semester Hr.
(I, II, S) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit: 0.5 to 6 credit hours. Repeatable for credit under different topics/ experience and maximums vary by department. Contact the Department for credit limits toward the degree.

MATH610. ADVANCED TOPICS IN DIFFERENTIAL EQUATIONS. 3.0 Semester Hrs.
(II) Topics from current research in ordinary and/or partial differential equations; for example, dynamical systems, advanced asymptotic analysis, nonlinear wave propagation, solitons. Prerequisite: none. 3 hours lecture; 3 semester hours.

MATH614. ADVANCED TOPICS IN APPLIED MATHEMATICS. 3.0 Semester Hrs.
(I) Topics from current literature in applied mathematics; for example, wavelets and their applications, calculus of variations, advanced applied functional analysis, control theory. Prerequisite: none. 3 hours lecture; 3 semester hours.

MATH616. INTRODUCTION TO MULTI-DIMENSIONAL SEISMIC INVERSION. 3.0 Semester Hrs.
(II) Introduction to high frequency inversion techniques. Emphasis on the application of this theory to produce a reflector map of the earth?s interior and estimates of changes in earth parameters across those reflectors from data gathered in response to sources at the surface or in the interior of the earth. Extensions to elastic media are discussed, as well. Includes high frequency modeling of the propagation of acoustic and elastic waves. Prerequisites: partial differential equations, wave equation in the time or frequency domain, complex function theory, contour integration. Some knowledge of wave propagation: reflection, refraction, diffraction. 3 hours lecture; 3 semester hours.

MATH650. ADVANCED TOPICS IN NUMERICAL ANALYSIS. 3.0 Semester Hrs.
(II) Topics from the current literature in numerical analysis and/or computational mathematics; for example, advanced finite element method, sparse matrix algorithms, applications of approximation theory, software for initial value ODE's, numerical methods for integral equations. 3 hours lecture; 3 semester hours. Prerequisite: Consent of Instructor.

MATH691. GRADUATE SEMINAR. 1.0 Semester Hr.
(I) Presentation of latest research results by guest lecturers, staff, and advanced students. Prerequisite: none. 1 hour seminar; 1 semester hour. Repeatable for credit to a maximum of 12 hours.

MATH692. GRADUATE SEMINAR. 1.0 Semester Hr.
Equivalent with CSCI692,
(II) Presentation of latest research results by guest lecturers, staff, and advanced students. Prerequisite: none. 1 hour seminar; 1 semester hour. Repeatable for credit to a maximum of 12 hours.

MATH693. WAVE PHENOMENA SEMINAR. 1.0 Semester Hr.
(I, II) Students will probe a range of current methodologies and issues in seismic data processing, with emphasis on under lying assumptions, implications of these assumptions, and implications that would follow from use of alternative assumptions. Such analysis should provide seed topics for ongoing and subsequent research. Topic areas include: Statistics estimation and compensation, deconvolution, multiple suppression, suppression of other noises, wavelet estimation, imaging and inversion, extraction of stratigraphic and lithologic information, and correlation of surface and borehole seismic data with well log data. Prerequisite: none. 1 hour seminar; 1 semester hour.

MATH698. SPECIAL TOPICS. 6.0 Semester Hrs.
(I, II, S) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once, but no more than twice for the same course content. Prerequisite: none. Variable credit: 0 to 6 credit hours. Repeatable for credit under different titles.

MATH699. INDEPENDENT STUDY. 0.5-6 Semester Hr.
(I, II, S) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit: 0.5 to 6 credit hours. Repeatable for credit under different topics/ experience and maximums vary by department. Contact the Department for credit limits toward the degree.

MATH707. GRADUATE THESIS / DISSERTATION RESEARCH CREDIT. 1-15 Semester Hr.
(I, II, S) GRADUATE THESIS/DISSERTATION RESEARCH CREDIT Research credit hours required for completion of a Masters-level thesis or Doctoral dissertation. Research must be carried out under the direct supervision of the student's faculty advisor. Variable class and semester hours. Repeatable for credit.

Department Head

G. Gustave Greivel, Teaching Professor

Professors

Greg Fasshauer

Mahadevan Ganesh

Paul A. Martin

Doug Nychka

Associate Professors

Soutir Bandopadhyay

Cecilia Diniz Behn

Dorit Hammerling

Stephen Pankavich

Luis Tenorio

Assistant professors

Eileen Martin

Daniel McKenzie

Brennan Sprinkle

Samy Wu Fung

Teaching Professors

Terry Bridgman

Debra Carney

Holly Eklund

Mike Nicholas

Jennifer Strong

Scott Strong

Rebecca Swanson

Teaching Associate Professors

Mike Mikucki

Ashlyn Munson

Teaching Assistant Professors

John Griesmer

Nathan Lenssen

Daisy Philtron

Emeriti Professors

William R. Astle

Bernard Bialecki

Norman Bleistein

Ardel J. Boes

Austin R. Brown

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