# Mathematics Courses

## Courses

**MATH 5195. Graduate Seminar.**
Graduate Seminar (1-0) Conferences and discussions of various topics in mathematics and statistics by faculty, graduate students, and outside speakers. Required of all graduate students during each semester of full-time enrollment. May not be counted more than once toward the degree requirement.
**Department:** Mathematics
**1 Credit Hour**
**1 Total Contact Hour**
0 Lab Hours
1 Lecture Hour
0 Other Hours

**MATH 5309. Intro to Applied Analysis.**
Introduction to Applied Analysis This course addresses the solvability of linear and nonlinear problems that arise in applications. Concepts will be introduced to equip students with the mathematical tools essential for an applied mathematician working with deterministic mathematical models.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 4341 w/B or better ) OR (MATH 5321 w/B or better)

**MATH 5311. Topics in Applied Mathematics.**
Topics in Applied Mathematics: Mathematics 5311 is designed to introduce the student to areas of mathematics that are useful in engineering and science. The course may be repeated as content changes.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours

**MATH 5321. Principles of Analysis.**
Principles of Analysis (3-0) Investigation of convergence, continuity, differentiability, compactness and connectedness, the Riemann-Stieljes integral, and sequences of functions. Prerequisite: MATH 3341.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 3341 w/C or better)

**MATH 5322. Linear Algebra.**
Linear Algebra This course offers a rigorous treatment of linear algebra, including vector spaces, linear transformations and matrix representations, canonical forms, eigenvalues and igenvectors, invariant subspaces, orthogonal and unitary transformations, and bilinear and quadratic forms. Emphasis will be given on proofs and abstract theory rather than on computation or concrete examples.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 3325 w/B or better)

**MATH 5325. Principles of Algebra.**
Principles of Algebra (3-0) Groups, including subgroups, quotient spaces, and homomorphisms. Ring theory, including ideals and quotients, homomorphisms, and polynomial rings. An introduction to modules and fields, including field extensions.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 3325 w/C or better)

**MATH 5329. Numerical Analysis.**
Numerical Analysis: Introduction to approximation theory, interpolation, numerical differentiation and integration, solutions of linear and non-linear equations, numerical solution of differential equations, optimization. Error, stability and complexity analysis will be done for many of the algorithms presented. Numerous practical examples and computer programs will be covered.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 3323 w/C or better)

**MATH 5330. Comp Methods of Linear Algebra.**
Computational Methods of Linear Algebra: Numerical methods involved in the computation of solutions of linear systems of equations, eigenvalues, linear least squares solutions, and linear programming. Error stability and complexity analysis will be done for many of the algorithms presented.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 3323 w/C or better)

**MATH 5331. Real Variables.**
Real Variables (3-0) Lebesgue integration, integration with respect to measure, absolute continuity, fundamental theorem of calculus for the lebesgue integral.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 5321 w/C or better)

**MATH 5335. Techniques in Optimization.**
Techniques in Optimization (3-0) An introduction to the formulation of optimization problems and their numerical solution with application to problems in science and engineering. Emphasis on deterministic and stochastic techniques such as Newton type methods and simulated annealing.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 1411 w/C or better ) OR (MATH 1312 w/C or better ) OR (MATH 2313 w/C or better ) OR (MATH 2326 w/C or better)

**MATH 5341. General Topology.**
General Topology (3-0) Topics include: Separation, compactness, connectedness, paracompactness, metric spaces and metrization of toplogical spaces.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 3341 w/C or better)

**MATH 5343. Numer Solution Part Diff Equat.**
Numerical Solutions to Partial Differential Equations: Introduction to finite difference and finite element methods for the solution of elliptic, parabolic and hyperbolic partial differential equations. Numerical implementation and convergence will be discussed for many of the algorithms proposed.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 2326 w/C or better ) OR (MATH 3326 w/C or better ) AND (MATH 3323 w/C or better ) AND (MATH 4329 w/C or better)

**MATH 5345. Numerical Optimization.**
Numerical Optimization (3-0) A study of numerical algorithms for solving systems of nonlinear equations, unconstrained optimization, and nonlinear least squares problems. Derivation of necessary and sufficient conditions for constrained optimization, and an introduction to interior-point methodology. Prerequisites: MATH 2313 and MATH 3323 each with a grade of "C" or better and knowledge of high-level computer language.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 2313 w/C or better ) OR (MATH 2326 w/C or better ) AND (MATH 3323 w/C or better)

**MATH 5351. Complex Variables.**
Complex Variables (3-0) Complex integration and the calculus of residues. Analytical continuation and expansions of analytic functions. Entire, meromorphic, and periodic functions.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 5321 w/C or better)

**MATH 5370. Special Topics.**
Special Topics: Various topics not included in regular courses will be discussed. May be repeated for credit as content changes.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours

**MATH 5380. Mathematical Statistics I.**
Mathematical Statistics I (3-0) The probabilistic foundations of mathematical statistics. Probability spaces, random variables, univariate and multivariate probability distributions, conditional distributions, expectation, generating functions, multivariate transfromations, modes of convergence and limit theorems.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (STAT 3330 w/C or better)

**MATH 5381. Mathematical Statistics II.**
Mathematical Statistics II (3-0) A continuation of Mathematical Statistics I. Parametric statistical models, sufficiency, exponential families, methods of estimation, comparison of estimators, confidence intervals, hypothesis testing, optimal tests, likelihood ratio tests, large sample theory. Prerequisite; MATH 5380 or STAT 5380 each with a grade of C or higher.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 5380 w/C or better ) OR (STAT 5380 w/C or better)

**MATH 5385. Statistics in Research.**
Statistics in Research (3-0) An introduction to statistical modeling of a univariate response conditional on a test of explanatory variables. Classical formulation of multiple linear regression and analysis of variance. Some discussion of experimental design from power considerations. Selected topics from generalized linear models, nonparametric regression, and quasi-likelihood estimation. Emphasis is on model building, fitting, validation, and subsequent inferences. Analysis of real data using major statistical software packages.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 3323 w/C or better ) AND (STAT 4380 w/C or better)

**MATH 5388. Multivariate Data Analysis.**
Multivariate Data Analysis (3-0) Statistical analysis of a multivariate response. Multivariate multiple linear regression, principal components, factor analysis, canonical correlation, and discriminate analysis. Applications with the use of statistical packages will be considered.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 5385 w/C or better ) OR (STAT 5385 w/C or better)

**MATH 5391. Time Series Analysis.**
Time Series Analysis (3-0) Time domain and frequency domain aspects of discrete time stationary processes, correlation functions, power spectra, filtering, linear systems, arma models for non-stationary series. An introduction to the analysis of multiple time series. Some use of statistical software will be included.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (MATH 5380 w/C or better)

**MATH 5392. Statistical Computing.**
Statistical Computing (3-0) A study of stochastic simulation and select numerical methods used in statistical computation.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**Prerequisite(s):** (STAT 4380 w/C or better)

**MATH 5396. Graduate Research.**
Graduate Research (0-0-3) A written report on an appropriate subject in mathematics or statistics is required. May not be counted towards the 24 hours of course work in the thesis option, but may be substituted for three hours of thesis credit.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
0 Lecture Hours
3 Other Hours
**Classification Restrictions:**
Excluded Class: DR

**MATH 5398. Thesis 1.**
Thesis 1
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
0 Lecture Hours
3 Other Hours

**MATH 5399. Thesis 2.**
Prerequisite: Department approval Thesis 2
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
0 Lecture Hours
3 Other Hours
**Prerequisite(s):** (MATH 5398 w/P or better)

**MATH 6195. Graduate Seminar.**
Graduate Seminar (1-0) Conferences and discussions of various topics in mathematics and statistics by faculty, graduate students, and outside speakers. Required of all graduate students during each semester of full-time enrollment. May not be counted more than once toward the degree requirement.
**Department:** Mathematics
**1 Credit Hour**
**1 Total Contact Hour**
0 Lab Hours
1 Lecture Hour
0 Other Hours

**MATH 6311. Topics in Applied Mathematics.**
This course prepares a student for research in applied mathematics on a specific topic. The topics may vary each semester. Each section is dedicated to a different topic. Course may be repeated for credit.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours

**MATH 6321. Measure and Probability Th.**
Measure and Probability Theory: Concepts such as Lebesgue measure and integration, basic convergence theorems, Lp spaces, Hilbert spaces, Banach spaces, Radon- Nikodym derivative, product spaces, product measures are developed for the study of probability spaces, random variables as measurable functions, modes of probabilistic convergence, expectation, conditional expectations and probability, statistical independence. Basic tools of probability theory are covered, such as characteristic functions, the weak and strong laws of large numbers, the central limit theorem, and martingales.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 5321 w/B or better ) AND (STAT 5380 w/B or better)

**MATH 6322. Principles of Analysis.**
Principles of Analysis (3-0) Investigation of convergence, continuity, differentiability, compactness and connectedness, the Riemann-Stieljes integral, and sequences of functions.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 3341 w/C or better)

**MATH 6325. Principles of Algebra.**
Principles of Algebra (3-0) Groups, including subgroups, quotient spaces, and homomorphisms. Ring theory, including ideals and quotients, homomorphisms, and polynomial rings. An introduction to modules and fields, including field extensions.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 3325 w/C or better)

**MATH 6329. Numerical Analysis.**
Numerical Analysis: Introduction to approximation theory, interpolation, numerical differentiation and integration, solutions of linear and non-linear equations, numerical solution of differential equations, optimization. Error, stability and complexity analysis will be done for many of the algorithms presented. Numerous practical examples and computer programs will be covered.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 3323 w/C or better)

**MATH 6330. Comp Methods of Linear Algebra.**
Computational Methods of Linear Algebra: Numerical methods involved in the computation of solutions of linear systems of equations, eigenvalues, linear least squares solutions, and linear programming. Error stability and complexity analysis will be done for many of the algorithms presented.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 3323 w/C or better)

**MATH 6331. Real Variables.**
Real Variables (3-0) Lebesgue integration, integration with respect to measure, absolute continuity, fundamental theorem of calculus for the lebesgue integral.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 5321 w/C or better)

**MATH 6335. Techniques in Optimization.**
Techniques in Optimization (3-0) An introduction to the formulation of optimization problems and their numerical solution with application to problems in science and engineering. Emphasis on deterministic and stochastic techniques such as Newton type methods and simulated annealing.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 1411 w/C or better ) OR (MATH 1312 w/C or better ) OR (MATH 2313 w/C or better ) OR (MATH 2326 w/C or better)

**MATH 6341. General Topology.**
General Topology (3-0) Topics include: Separation, compactness, connectedness, paracompactness, metric spaces and metrization of toplogical spaces.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 3341 w/C or better)

**MATH 6343. Numer Solution Part Diff Equat.**
Numerical Solutions to Partial Differential Equations: Introduction to finite difference and finite element methods for the solution of elliptic, parabolic and hyperbolic partial differential equations. Numerical implementation and convergence will be discussed for many of the algorithms proposed.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 2326 w/C or better ) OR (MATH 3326 w/C or better ) AND (MATH 3323 w/C or better ) AND (MATH 4329 w/C or better)

**MATH 6345. Topics in Optimization.**
The topics may vary each semester. Course may be repeated for credit.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 5345)

**MATH 6351. Complex Variables.**
Complex Variables (3-0) Complex integration and the calculus of residues. Analytical continuation and expansions of analytic functions. Entire, meromorphic, and periodic functions.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 5321 w/C or better)

**MATH 6370. Special Topics.**
Special Topics: Various topics not included in regular courses will be discussed. May be repeated for credit as content changes.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours

**MATH 6380. Mathematical Statistics I.**
Mathematical Statistics I (3-0) The probabilistic foundations of mathematical statistics. Probability spaces, random variables, univariate and multivariate probability distributions, conditional distributions, expectation, generating functions, multivariate transformations, modes of convergence and limit theorems.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (STAT 3330 w/C or better)

**MATH 6381. Theory of Inference for DS.**
Theory of Inference for Data Science: Theory of estimation and sufficiency including maximum likelihood and minimum variance estimation suitable for large throughput data; Neyman-Pearson theory of testing hypotheses; elements of decision theory; Asymptotic results for large scale estimation and testing based on likelihoods, general estimating equations, empirical Bayesian estimation and resampling plans.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 5381 w/B or better ) OR (STAT 5381 w/B or better)

**MATH 6382. Mathematical Statistics II.**
Mathematical Statistics II (3-0) A continuation of Mathematical Statistics I. Parametric statistical models, sufficiency, exponential families, methods of estimation, comparison of estimators, confidence intervals, hypothesis testing, optimal tests, likelihood ratio tests, large sample theory.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 5380 w/C or better ) OR (STAT 5380 w/C or better)

**MATH 6385. Statistics in Research.**
Statistics in Research (3-0) An introduction to statistical modeling of a univariate response conditional on a test of explanatory variables. Classical formulation of multiple linear regression and analysis of variance. Some discussion of experimental design from power considerations. Selected topics from generalized linear models, nonparametric regression, and quasi-likelihood estimation. Emphasis is on model building, fitting, validation, and subsequent inferences. Analysis of real data using major statistical software packages.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 3323 w/C or better ) AND (STAT 4380 w/C or better)

**MATH 6386. Stochastic Dif Eqns and Ap.**
Stochastic Differential Equations and Applications: Stochastic analogous of classical differnetial equations, random variables and stochastic processes, martingales; the Ito integral, the Ito formula, one dimensional and multi dimensional, martingale representation theorem; stochastic differential equations: solution methods, existence and uniqueness theorem, weak and strong solutions; diffusions: the Markov property, the generator of an Ito's diffusion, the charecteristic operator; applications of stochastic differential equations in finance: the Black-Scholes option pricing formula; market, portfolio and arbitrage; change of measure.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 5321 w/B or better AND STAT 5380 w/B or better)

**MATH 6388. Multivariate Data Analysis.**
Multivariate Data Analysis (3-0) Statistical analysis of a multivariate response. Statistical analysis of a multivariate response. components, factor analysis, canonical correlation, and discriminate analysis. Applications with the use of statistical packages will be considered.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 5385 w/C or better ) OR (STAT 5385 w/C or better)

**MATH 6391. Time Series Analysis.**
Time Series Analysis (3-0) Time domain and frequency domain aspects of discrete time stationary processes, correlation functions, power spectra, filtering, linear systems, arma models for non-stationary series. An introduction to the analysis of multiple time series. Some use of statistical software will be included.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (MATH 5380 w/C or better)

**MATH 6392. Statistical Computing.**
Statistical Computing (3-0) A study of stochastic simulation and select numerical methods used in statistical computation.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
3 Lecture Hours
0 Other Hours
**Prerequisite(s):** (STAT 4380 w/C or better)

**MATH 6396. Graduate Research.**
Graduate Research (0-0-3) A written report on an appropriate subject in mathematics or statistics is required. May not be counted towards the 24 hours of course work in the thesis option, but may be substituted for three hours of thesis credit.
**Department:** Mathematics
**3 Credit Hours**
**3 Total Contact Hours**
0 Lab Hours
0 Lecture Hours
3 Other Hours