The courses offered by the Department of Mathematics serve several purposes; they supply the mathematical preparation necessary for students specializing in the physical, life or social sciences, in business administration, in engineering, and in education; they provide a route by which students may achieve a level of competence to do research in any of several special mathematical areas; they allow students to prepare themselves for work as mathematicians and statisticians in industry and government; and they give an opportunity to all inquisitive students to learn something about modern mathematical ideas.

For details on Mathematics course placement, please see the Mathematics Placement Information section of this bulletin, or the Mathematics Placement Exam information provided by the Office of Testing, Evaluation and Research Services.

BERMAN, ROBERT D.: Ph.D., University of Maryland; M.A., B.A., Wesleyan University; Professor

BRECKENRIDGE, JOHN C.: Ph.D., M.A., University of Michigan; B.A., Oberlin College; Associate Professor Emeritus

BRENTON, LAWRENCE: Ph.D., University of Washington; B.A., University of Pennsylvania; Professor Emeritus

BRUNER, ROBERT R.: Ph.D., M.S., University of Chicago; B.A., Amherst College; Professor

BUCKMAN, MATTHEW: Ph.D., M.A., Wayne State University; B.A., University of Michigan; Lecturer

CELIK, FATIH: Ph.D., University of Minnesota; M.S., B.S., Bogazici University; Associate Professor

CHOW, PAO-LIU: Ph.D., Rensselaer Polytechnic Institute; B.S., National Cheng Kung University; Professor

COHN, WILLIAM S.: Ph.D., University of Wisconsin; B.A., Oberlin College; Professor

CORRIGAN-SALTER, BRUCE: Ph.D., M.A., University at Buffalo; B.S., Aquinas College; Lecturer

DIWADKAR, JYOTSNA: Ph.D., University of Pittsburgh; M.S., Indiana State University; B.S., St. Xavier’s College; Lecturer

DRUCKER, DANIEL: Ph.D., M.A., University of California, Berkeley; B.S., Massachusetts Institute of Technology; Professor

FROHARDT, DANIEL: Ph.D., M.A., University of California, Berkeley; B.A., Grinnell College; Professor

FURTADO, ANDRE: Ph.D., M.S., B.S., University of Michigan; B.S., Bombay University; Assistant Professor

GLUCK, DAVID: Ph.D., M.S., University of Chicago; B.A., University of California at Los Angeles; Professor Emeritus

HOCHSTADT, CAROLYN: M.A., B.S., Wayne State University; Lecturer

HU, PO: Ph.D., University of Michigan; B.A., Yale University; Professor

ISAKSEN, DANIEL: Ph.D., M.S., University of Chicago; B.A., University of California, Berkeley; Professor

KAHN, STEVEN M.: Ph.D., M.A., University of Maryland; B.S., State University of New York at Stony Brook; Professor

KAILI, HARDAMON: M.A.T., University of Phoenix; B.S. University of Michigan; Lecturer

KHASMINSKI, RAFAIL: Ph.D., DrSci, M.A., Moscow State University; Distinguished Professor Emeritus

KLAKULAK, MELINDA: M.A., B.A., Wayne State University; Lecturer

KLEIN, JOHN R.: Ph.D., M.A., Brandeis University; B.A., Northwestern University; Professor

KOROSTELEV, ALEXANDER P.: Dr.Sc., Russian Academy of Science; Ph.D., M.S., Moscow State University; Professor

KUMAR, ROHINI: Ph.D., University of Wisconsin-Madison; M.S., B.S., Bangalore University; Assistant Professor

LEIBIEDZIK, CATHERINE: Ph.D., M.A., University of Virginia; B.S., Pennsylvania State University; Associate Professor

LEE, KYUNG-YONG: Ph.D., University of Michigan; B.A., Seoul National University; Assistant Professor

LEIRSTEIN, CHRISTOPHER: M.A., B.S., Wayne State University; Lecturer

LI, HENGGUANG: Ph.D., Pennsylvania State University; B.S., Peking University; Associate Professor and Chair

MAHABIR, NARESH: M.A., B.A., Wayne State University; Lecturer

MAKAR-LIMANOV, LEONID: M.S., Ph.D., Moscow State University; Professor

MEI, TAO: Ph.D., Texas A&M University; Assistant Professor

MORDUKHOVICH, BORIS S.: Ph.D., M.S., Byelorussian State University; Distinguished Professor

NAZELLI, CHRISTOPHER: M.A., B.A., Wayne State University; Senior Lecturer

OKOH, FRANK: Ph.D., M.S., Queen’s University; B.S., Imperial College of Science and Technology; Professor

PINEAU, RICHARD: M.A., B.A., Wayne State University; Lecturer

RASKIND, WAYNE: Ph.D., University of Cambridge; B.A., University of Pennsylvania; Professor

SALCH, ANDREW: Ph.D., M.A., University of Rochester; B.S. Portland State University; Assistant Professor

SCHOCHET, CLAUDE L.: Ph.D., M.S., University of Chicago; B.A., University of Minnesota; Professor Emeritus

SCHREIBER, BERTRAM M.: Ph.D., M.S., University of Washington; B.S., Yeshiva University; Professor

SCHULTZ, SHEREEN: M.S., University of Texas at Arlington; B.S., Michigan Technological University; Lecturer
SHERRY, DONALD: M.A., B.S., Wayne State University; Senior Lecturer
SHINKI, KAZUHIKO: Ph.D., University of Wisconsin-Madison; M.S., University of Tokyo; B.S., Waseda University; Assistant Professor
SUN, TZE-CHEIN: Ph.D., Brown University; B.S., National Taiwan University; Professor
UMIRBAEV, UALBAI: Ph.D., D.Sc. Sobolev Institute of Mathematics; M.S., Novosibirsk State University; Professor
VINCENTINI, ANDREW: M.Ed., B.S., Wayne State University; Lecturer
WANG, PEI-YONG: Ph.D., Courant Institute of Mathematical Sciences, New York University; M.S., Institute of Mathematics, Academia Sinica; B.S., Tsinghua University; Associate Professor
YIN, GANG: Ph.D., M.S., Brown University; B.S., University of Delaware; Professor
ZHANG, SHENG: Ph.D., Pennsylvania State University; Ph.D., Chinese Academy of Sciences; M.S., Xian Jiaotong University; B.S., Northwestern University of China; Associate Professor
ZHANG, ZHIMIN: Ph.D., University of Maryland at College Park; M.S., B.S., University of Science and Technology; Professor

• Actuarial Mathematics (B.A.) (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/mathematics/actuarial-mathematics-ba)
• Mathematics (B.A.) (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/mathematics/mathematics-ba)
• Mathematics (B.S.) (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/mathematics/mathematics-bs)
• Statistics (B.S.) (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/mathematics/statistics-bs)
• Statistics Minor (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/mathematics/statistics-minor)
• Mathematics Minor (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/mathematics/mathematics-minor)
• Advanced Courses for Non-Majors (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/mathematics/advanced-courses-non-majors)

For details on Mathematics prerequisite requirements, please see the Mathematics Placement Information (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/mathematics/placement) section of this bulletin, or the Mathematics Placement Exam (http://testing.wayne.edu/register/math-placement-exam.php) information provided by the Office of Testing, Evaluation and Research Services.

**Mathematics**

**MAT 0993 Beginning Algebra Cr. 3,5**
Satisfies General Education Requirement: Web Based Course
Course Material Fees: $124

**MAT 0995 Intermediate Algebra Cr. 3**
Exponents and radicals, solving polynomial and other types of equations and inequalities, graphs and systems of linear equations, introduction to functions, elementary geometry. No credits apply toward degree. Offered Every Term.
Prerequisites: MAT 0993 with a minimum grade of CNC or Math Permit to Reg - L1-L4 with a test score minimum of 11709-19999 or Math Permit to Reg - L1-L4 with a test score minimum of 21709-29999 or Math Permit to Reg - L1-L4 with a test score minimum of 31709-39999 or MAT Permit to Reg ACT/SAT with a test score minimum of 11709-19999 or MAT Permit to Reg ACT/SAT with a test score minimum of 21709-29999 or MAT Permit to Reg ACT/SAT with a test score minimum of 31709-39999 or MQE Math Permit to Reg L0-L3 with a test score minimum of 11709-19999 or MQE Math Permit to Reg L0-L3 with a test score minimum of 21709-29999 or MQE Math Permit to Reg L0-L3 with a test score minimum of 31709-39999
Restriction(s): Enrollment is limited to Undergraduate level students.
Course Material Fees: $124

**MAT 1000 Mathematics in Today’s World Cr. 3**
Satisfies General Education Requirement: Quantitative Experience Comp
An exploration of current applications of mathematics, such as gerrymandering, consumer mathematics, cryptography, identification numbers, art, music, statistical design, optimal decision making, and risk assessment. Offered Every Term.
Restriction(s): Enrollment is limited to Undergraduate level students.

**MAT 1050 Algebra With Trigonometry Cr. 5,7**
Satisfies General Education Requirement: Quantitative Experience Comp
Algebra: properties of the real number system, equations and inequalities, lines, graphs, introduction to functions, exponents, logarithms. Geometry and trigonometry: basic concepts, introduction to trigonometric functions, solving right triangles. Mathematics, mathematics education, science, and engineering majors should elect the 7-credit version of this course. If elected for 5 credits, only 2 credits apply toward degree; if elected for 7 credits, only 3 credits apply toward degree. Offered Every Term.
Prerequisites: MAT 0993 with a minimum grade of CNC or MAT Permit to Reg ACT/SAT with a test score minimum of 2-4 or Math Permit to Reg - L1-L4 with a test score minimum of 2-4

**MAT 1110 Mathematics for Elementary School Teachers I Cr. 3**
Satisfies General Education Requirement: Quantitative Experience Comp
Problem solving, sets, functions, reasoning, number theory, whole numbers, integers, fractions, decimals. Offered Fall, Winter.
Prerequisites: MAT 1050 with a minimum grade of C- or MAT 0995 with a minimum grade of C- or Math Permit to Reg - L1-L4 with a test score minimum of 3-4 or MAT Permit to Reg ACT/SAT with a test score minimum of 3-4

**MAT 1120 Mathematics for Elementary School Teachers II Cr. 3**
Satisfies General Education Requirement: Quantitative Experience Comp
Statistics, probability, geometry, and measurement. Offered Fall, Winter.
Prerequisites: MAT 1110 with a minimum grade of C- or MAT Permit to Reg ACT/SAT with a test score minimum of 3-4 or Math Permit to Reg - L1-L4 with a test score minimum of 3-4
MAT 1500 College Algebra for the Social and Management Sciences Cr. 3
Satisfies General Education Requirement: Quantitative Experience Comp
Equations and inequalities, graphs and functions, polynomial and rational
functions, exponential and logarithmic functions. Offered Every Term.
Prerequisites: MAT 1050 with a minimum grade of C- or MAT 0995 with
a minimum grade of C- or MAT Permit to Reg ACT/SAT with a test score
minimum of 3-4 or Math Permit to Reg - L1-L4 with a test score minimum of
3-4
Course Material Fees: $124

MAT 1800 Elementary Functions Cr. 4
Satisfies General Education Requirement: Quantitative Experience Comp
Basic definition and concept of function. Definitions, properties and
graphs of polynomial, rational, exponential, logarithmic, trigonometric,
and inverse trigonometric functions. Only two degree credits after
MAT 1500. Offered Every Term.
Prerequisites: MAT 1050 with a minimum grade of C- or MAT Permit to
Reg ACT/SAT with a test score minimum of 3-4 or Math Permit to Reg -
L1-L4 with a test score minimum of 3-4

MAT 1990 Precalculus Workshop Cr. 2
Students work cooperatively in groups to solve challenging problems
related to precalculus. Learning is through discovery rather than by
lecture. Offered Every Term.

MAT 2010 Calculus I Cr. 4
Satisfies General Education Requirement: Quantitative Experience Comp
Calculus as the study of change. Definitions, concepts, and
interpretations of the derivative and the definite and indefinite integrals;
differentiation, integration, applications. No credit after former MAT 1510.
Offered Every Term.
Prerequisites: MAT 1800 with a minimum grade of C- or MAT Permit to
Reg ACT/SAT with a test score minimum of 4 or Math Permit to Reg -
L1-L4 with a test score minimum of 4

MAT 2020 Calculus II Cr. 4
Satisfies General Education Requirement: Quantitative Experience Comp
Review definition of definite integral and fundamental theorem of
integration. Techniques of integration; approximate integration;
improper integrals; applications of integration. Sequences and series.
Approximating functions by polynomials and Taylor series. Offered Every
Term.
Prerequisites: MAT 2010 with a minimum grade of C-

MAT 2030 Calculus III Cr. 4
Multivariable calculus with applications. Vectors and vector functions in
two and three dimensions; functions of several variables; differentiation;
integration; vector calculus. Offered Every Term.
Prerequisites: MAT 2020 with a minimum grade of C-

MAT 2110 Calculus Workshop I Cr. 2
Students work cooperatively in groups to solve challenging problems
related to calculus. Learning is through discovery rather than by lecture.
Offered Every Term.
Prerequisite: MAT 2010 (may be taken concurrently) with a minimum
grade of C

MAT 2120 Calculus Workshop II Cr. 2
Students work cooperatively in groups to solve challenging problems
related to calculus. Learning is through discovery rather than by lecture.
Offered Winter.
Prerequisite: MAT 2020 (may be taken concurrently) with a minimum
grade of C

MAT 2150 Differential Equations and Matrix Algebra Cr. 4
Differential equations and applications; basic operations of matrices
from linear algebra. Only one degree credit after MAT 2350. Offered Every
Term.
Prerequisites: MAT 2030 with a minimum grade of C-

MAT 2210 Probability and Statistics Cr. 4
Satisfies General Education Requirement: Quantitative Experience Comp
Basic probability theory (definition of probability, conditional probability,
development, random variables, expectation and variance, normal
distribution, law of large numbers, central limit theorem), descriptive
statistics (histograms, scatter plots, box plots, mean, variance, quantiles,
empirical rule, z-scores), statistical inference (confidence intervals for
mean, t-tests, chi-square tests, linear regression, analysis of variance) and
data analysis. Offered Every Term.
Prerequisites: MAT 1800-6999 with a minimum grade of C- or MAT Permit
to Reg ACT/SAT with a test score minimum of 4 or Math Permit to Reg -
L1-L4 with a test score minimum of 4

MAT 2250 Elementary Linear Algebra Cr. 3
Topics include: systems of linear equations, matrices, vector spaces,
basis, dimension, inner products, linear transformations and eigenvalues.
Applications presented. Offered Every Term.
Prerequisites: MAT 2020 with a minimum grade of C-

MAT 2350 Elementary Differential Equations Cr. 3
Topics include: first order equations, higher order linear equations,
Laplace transforms, linear systems. Applications presented throughout
the course. No degree credit after MAT 2150. Offered Every Term.
Prerequisites: MAT 2030 with a minimum grade of C- and MAT 2250 with
a minimum grade of C-

MAT 2860 Discrete Mathematics Cr. 3
Foundations of mathematics: logic and mathematical reasoning;
sets, functions, sequences; the integers and the Euclidean algorithm;
induction, recursive definitions and recurrence relations; graphs.
Combinatorics. Graph theory. Boolean algebra. No credit after former
MAT 1860 or 1870. Offered Yearly.
Prerequisites: MAT 2010 with a minimum grade of C-

MAT 3430 Applied Differential and Integral Calculus Cr. 4
Limits, derivatives, applications of derivatives, definite integrals and their
applications, and trigonometric functions. No degree credit in College of
Liberal Arts and Sciences. Offered Every Term.
Prerequisites: MAT 1800 with a minimum grade of C-
Equivalent: ET 3430

MAT 3450 Applied Calculus and Differential Equations Cr. 4
Continuation of MAT 3430, including logarithmic and exponential
functions, first and second order ordinary differential equations, vectors,
polar coordinates, Laplace transforms, Taylor series, and Fourier series.
No degree credit in College of Liberal Arts and Sciences. Offered Every
Term.
Prerequisite: MAT 3430 with a minimum grade of C-
Equivalent: ET 3450

MAT 4990 Directed Study: Honors Program Cr. 1-4
Offered Irregularly.
Repeatable for 8 Credits

MAT 5000 Fundamental Concepts of Mathematics and Proof Writing Cr. 3
Fundamental concepts: basic logic, basic set theory, functions,
equivalence relations. Proof: methods of proof, structures of proofs,
proof-writing in a variety of mathematical subjects. Not considered a
5000+ level course for undergrad. degree requirements in mathematics;
no credit towards graduate degree in mathematics. Offered Fall, Winter.
Prerequisites: MAT 2250 with a minimum grade of C- or MAT 2860 with a
minimum grade of C-
MAT 5030 Statistical Computing and Data Analysis Cr. 3
Computational aspect of statistics and data analysis for advanced
undergraduate and beginning graduate students. Topics include
descriptive statistics, probability distribution, hypothesis testing,
ANOVA, linear regression and logistic regression. Data analysis by use of
statistical packages such as R, SAS, Python, SPSS or Minitab. Satisfies
Society of Actuaries Validation by Educational Experience (VEE) in
Applied Statistics for regression component with a B- or better. Offered
Yearly.
Prerequisites: MAT 2250 with a minimum grade of C- or MAT 2150 with
a minimum grade of C- and MAT 2210 with a minimum grade of C- or
MAT 5700 with a minimum grade of C- or BE 2100 with a minimum
grade of C- or ECO 5100 with a minimum grade of C- or PH 3200 with a
minimum grade of C-.

MAT 5070 Elementary Analysis Cr. 4
Topics include: the real numbers, cardinality, sequences, limits, continuity,
uniform continuity, differentiation, integration. Offered Every Term.
Prerequisites: 1 of MAT 2250, MAT 2350, MAT 2150 and MAT 2030 with a
minimum grade of C-.

MAT 5100 Numerical Methods I Cr. 3
Numerical errors; solutions of nonlinear equations; polynomial
interpolation; numerical approximation; numerical integration and
differentiation; numerical solutions of systems of linear equations;
numerical solutions of ordinary differential equations. Offered Yearly.
Prerequisites: 1 of CSC 1100, CSC 1101, BE 1500 and MAT 2030 with a
minimum grade of C- and MAT 2250 with a minimum grade of C-.

MAT 5110 Numerical Methods II Cr. 3
Numerical linear algebra topics, including eigenvalue problems,
conjugate-gradient method, GMRES method; numerical solution of
ordinary differential equations, Runge-Kutta methods; numerical
solutions of partial differential equations, finite difference methods.
Offered Winter.
Prerequisites: MAT 5100 with a minimum grade of C- and MAT 2150 with
a minimum grade of C- or MAT 2350 with a minimum grade of C-.

MAT 5120 Abstract Algebra for Middle School Teachers Cr. 3
Topics from elementary abstract algebra underpinning middle school
mathematics curriculum; historical connections; role of abstraction and
proof in mathematics. No credit towards major in mathematics or
secondary mathematics. Offered for undergraduate credit only. Offered
Fall, Winter.
Prerequisites: MAT 1120 with a minimum grade of C- and MAT 1800 with
a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.
Equivalent: MAE 5120

MAT 5130 Problem Solving for Middle School Teachers Cr. 3
Development of mathematical problem solving in middle grades
mathematics education; study of non-routine problems; problem
solving strategies; historical connections; connections to selected
mathematics content and to topics in other disciplines. No credit towards
a mathematics major or secondary mathematics education major.
Offered for undergraduate credit only. Offered Spring/Summer.
Prerequisites: MAT 1120 with a minimum grade of C- and MAT 1800 with
a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.
Equivalent: MAE 5130

MAT 5180 Geometry for Middle School Teachers Cr. 3
Development of Euclidean geometry as a mathematical system; related
historical topics; introduction to other geometries; selected topics such as
transformations and tessellations. No credit toward a major or minor
for secondary mathematics teaching. Offered for undergraduate credit
only. Offered Fall, Winter.
Prerequisites: MAT 1110 with a minimum grade of C- and MAT 1120 with
a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.
Equivalent: MAE 5100

MAT 5190 Number Theory for Middle School Teachers Cr. 3
Topics from elementary theory of numbers which underlie middle
school mathematics; historical connections; role of abstraction and
proof in mathematics. No credit toward a major or minor for secondary
mathematics teaching. Offered for undergraduate credit only. Offered Fall,
Winter.
Prerequisites: MAT 1800 with a minimum grade of C- or MAT 1120 with a
minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.
Equivalent: MAE 5110

MAT 5210 Advanced Calculus Cr. 4
Functions of many variables; limits, continuity; differentiation, mean value
theorems; implicit and inverse function theorems; extremal problems,
Lagrange multipliers; fixed-point methods; Taylor series; Fourier series,
uniform convergence; improper integrals. Offered Yearly.
Prerequisites: MAT 2250 with a minimum grade of C-

MAT 5220 Partial Differential Equations Cr. 4
Partial differential equations of mathematical physics; method of
separation of variables; Fourier series; Sturm-Liouville eigenvalue
problems; boundary-value problems; method of eigenfunction expansion.
Optional topics include: green functions; solutions by Fourier transform;
method of characteristics. Offered Biannually.
Prerequisites: MAT 5070 with a minimum grade of C-

MAT 5230 Complex Variables and Applications Cr. 4
Cauchy-Riemann equations; elementary functions; mappings
by elementary functions; the Cauchy integral formula; Morera's
theorem; Taylor series; Laurent series; residues and poles; conformal
mappings. Optional topics: improper integrals, the Schwarz-Christoffel
transformations; potential theory; applications in differential and integral
equations. No credit after MAT 6600. Offered Biannually.
Prerequisites: MAT 5070 with a minimum grade of C-

MAT 5280 Methods of Differential Equations Cr. 3
Linear nth order differential equations; linear systems of differential
equations (constant and periodic coefficients); oscillation and
comparison theorems for second order differential equations; boundary
value problems; stability theory (Liapunov's direct method and frequency
domain stability criteria); asymptotic solutions; autonomous non-linear
systems; classification of singularities. Offered Biannually.
Prerequisites: MAT 2150 with a minimum grade of C- or MAT 2350 with a
minimum grade of C-

MAT 5350 Logical Systems I Cr. 4
Metareasons concerning formal systems of sentential and first-order
logics; soundness, completeness; independence of axioms; introduction
to recursive functions; formalization of elementary arithmetic; discussion
of Godel's incompleteness theorem and Church's Theorem. Offered
Biannually.
Prerequisites: MAT 5600 with a minimum grade of C- or PHI 1850 with a
minimum grade of C- or PHI 1860 with a minimum grade of C- or PHI 5050
with a minimum grade of C- or MAT 5420 with a minimum grade of C-
Equivalent: PHI 5350
MAT 5400 Elementary Theory of Numbers Cr. 3
Primes and the Fundamental Theorem of Arithmetic; greatest common divisor, least common multiple, Euclidean Algorithm; congruences, theorems of Fermat, Wilson and Euler; arithmetic functions; linear Diophantine equations; quadratic congruences and the Law of Quadratic Reciprocity. Optional topics include: applications to cryptography, perfect numbers, primitive roots and indices, Fibonacci numbers, Pythagorean triples, sums of squares, continued fractions. Offered Yearly.
Prerequisites: MAT 2030 with a minimum grade of C- and MAT 2250 with a minimum grade of C-

MAT 5410 Applied Linear Algebra Cr. 4
Gaussian elimination, vector spaces, the four fundamental subspaces, orthogonality, least squares approximation, determinants, eigenvalues and eigenvectors, positive definite matrices, singular value decomposition, linear transformations, complex matrices. Applications such as differential and difference equations, Markov processes, graphs and networks, Fourier series, computer graphics, numerical linear algebra. Offered Biannually.
Prerequisites: MAT 2030 with a minimum grade of C- and MAT 2250 with a minimum grade of C-

MAT 5420 Algebra I Cr. 4
Abstract concepts: sets, mappings, equivalence relations, induction, general methods of proof. Group theory: groups, subgroups, cyclic groups, direct products, cosets, Lagrange's Theorem, quotient groups, homomorphisms, permutation groups. Rings and fields (basic definitions). Only two credits apply after either MAT 6170 or 6180; no credit after both MAT 6170 and 6180. Offered Every Term.
Prerequisites: MAT 2030 with a minimum grade of C- and MAT 2250 with a minimum grade of C-

MAT 5430 Algebra II Cr. 4
Prerequisites: MAT 5420 with a minimum grade of C-

MAT 5520 Introduction to Topology Cr. 3
An introduction to topology, mostly through an intuitive approach. Topics chosen from among: topological equivalence and topological properties, complexes, Euler characteristic, connectedness, compactness, continuity, Brouwer's Fixed Point Theorem, vector fields, Hairy Ball Theorem, n-dimensional spaces, classification of surfaces, cut and paste techniques, the Moebius band, orientability, the fundamental group. No credit toward graduate degree in mathematics or statistics. Offered Yearly.
Prerequisites: MAT 2030 with a minimum grade of C- and MAT 5000 with a minimum grade of C-

MAT 5530 Elementary Differential Geometry and its Applications Cr. 3
Introduction to the differential geometry of curves and surfaces in three-dimensional space. Curvature, torsion, Frenet formulas, fundamental theorem of space curves. Gauss and mean curvature, asymptotic and principal curves, geodesics, Gauss-Bonnet theorem. Applications such as pursuit curves, roulette, brachistochrones, precession of Foucault's pendulum, design of packaging machines, shapes and soap films. Offered Irregularly.
Prerequisites: MAT 2030 with a minimum grade of C- and MAT 2250 with a minimum grade of C-

MAT 5600 Introduction to Analysis I Cr. 4
Completeness, convergence, compactness, connectedness and continuity in the context of metric spaces; applications to differential calculus. Offered Every Term.
Prerequisites: MAT 5070 with a minimum grade of C-

MAT 5610 Introduction to Analysis II Cr. 3
Integration, point-wise and uniform convergence of sequences and series of functions; power series; introduction to analytic functions; Fourier series; possible additional topics. Offered Every Term.
Prerequisites: MAT 5600 with a minimum grade of C-

MAT 5700 Introduction to Probability Theory Cr. 4
Probability spaces; combinatorial analysis; independence and conditional probability; discrete and continuous random variables including binomial, Poisson, exponential and normal distributions; expectations; joint, marginal and conditional distribution functions; law of large numbers; central limit theorems. Offered Every Term.
Prerequisites: 1 of MAT 2150, MAT 2250, MAT 2350 and MAT 2030 with a minimum grade of C-

MAT 5710 Introduction to Stochastic Processes Cr. 3
Non-measure-theoretic introduction to the theory of stochastic processes and its applications, with emphasis on Markov processes in both discrete and continuous time, the Poisson process, and Brownian motion. Offered Biannually.
Prerequisites: MAT 5700 with a minimum grade of C-

MAT 5740 The Theory of Interest Cr. 3
Concrete problems used to explore concepts in the theory of interest, including measurement of interest, annuities, yield rates, amortization, bonds, and stochastic approaches. Students prepare for the actuarial examination FM/2. Offered Yearly.
Prerequisites: MAT 2020 with a minimum grade of C-

MAT 5770 Mathematical Models in Operations Research Cr. 3
Deterministic and probabilistic mathematical modeling of real-world problems. Linear and nonlinear programming, Markov chains; queueing theory; inventory models; Markov decision processes. Offered Biannually.
Prerequisites: MAT 2030 with a minimum grade of C-, MAT 2250 with a minimum grade of C-, and MAT 5700 with a minimum grade of C-

MAT 5800 Introduction to Mathematical Statistics Cr. 4
A one-semester course for senior undergraduate and master's degree students. Introduction to basic mathematical theory of statistics. Topics include survey sampling, estimation theory, data analysis and sample statistics, testing hypothesis, two sample cases, analysis of variance, regression analysis, Bayesian inference. Satisfies Society of Actuaries Validation by Educational Experience (VEE) in Applied Statistics for regression component with a B- or better Offered Yearly.
Prerequisite: MAT 5700 with a minimum grade of C-

MAT 5830 Applied Time Series Cr. 3
Time series models, moving average models, autoregressive models, non-stationary models, and more general models; point estimators, confidence intervals, and forecast in the time domain. Statistical analysis in the frequency domain; spectral density and periodogram. Satisfies Society of Actuaries Validation by Educational Experience (VEE) in Applied Statistics for regression component with a B- or better Offered Biannually.
Prerequisites: MAT 2250 with a minimum grade of C- or MAT 2150 with a minimum grade of C- and MAT 2210 with a minimum grade of C- or BE 2100 with a minimum grade of C- or ECO 5100 with a minimum grade of C- or PH 3200 with a minimum grade of C-

MAT 5870 Methods of Optimization Cr. 3
Introduction to basic mathematical theory and computational methods of optimization; unconstrained and constrained optimization problems; optimality conditions in various optimization problems; numerical methods of optimization. Offered Yearly.
Prerequisites: MAT 2150 with a minimum grade of C- or MAT 2350 with a minimum grade of C-
MAT 5890 Special Topics in Mathematics Cr. 3-4
Material currently of interest to students and faculty. Topics to be announced in Schedule of Classes. Offered Irregularly.
Prerequisites: 1 of MAT 2250, MAT 2350, MAT 2150 and MAT 2030 with a minimum grade of C-
Repeatable for 12 Credits

MAT 5990 Directed Study Cr. 1-4
Undergraduates who elect this course must be mathematics majors of honors caliber. Content will vary to satisfy needs of individual student. Offered Every Term.
Repeatable for 8 Credits

MAT 5992 Teaching Mathematics in College Cr. 1
Preparation for first semester of teaching in developmental-level mathematics course. Content presentation, test-writing, grading, classroom management, use of technology. Students are videotaped and critiqued. Required of all graduate teaching assistants in Mathematics Department. Offered for S and U grades only. Offered Fall.
Restriction(s): Enrollment is limited to Graduate or Undergraduate level students; enrollment limited to students with a class of Senior; enrollment is limited to students with a major in Mathematics or Mathematics Honors.

MAT 5993 Writing Intensive Course in Mathematics Cr. 0
Satisfies General Education Requirement: Writing Intensive Competency Discipline writing assignments under the direction of a faculty member. Must be selected in conjunction with a course designated as a corequisite. See section listing in Schedule of Classes for corequisites available each term. Satisfies the University General Education Writing-Intensive Course in the Major requirement. Required for all majors. Offered Every Term.
Prerequisites: MAT 2030 with a minimum grade of C- and MAT 2250 with a minimum grade of C- and ENG 2100 with a minimum grade of C or ENG 2210 with a minimum grade of C or ENG 2310 with a minimum grade of C or ENG 2390 with a minimum grade of C or ENG 2420 with a minimum grade of C or ENG 2560 with a minimum grade of C or ENG 2570 with a minimum grade of C or ENG 3010 with a minimum grade of C
Restriction(s): Enrollment is limited to Undergraduate level students.

MAT 6130 Discrete Mathematics Cr. 3
Prerequisites: MAT 2010 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Education.

MAT 6140 Geometry: An Axiomatic Approach Cr. 3
Foundations: logic, axiom systems, models; Hilbert’s axioms; the parallel postulate; Euclidean geometry; non-Euclidean geometries; hyperbolic geometry; philosophical questions. Offered Yearly.
Prerequisites: MAT 5000 with a minimum grade of C-

MAT 6150 Probability and Statistics for Teachers Cr. 4
Counting techniques, discrete sample spaces and probability, random variables, mean and variance, joint distributions, the binomial and normal distributions, central limit theorem, estimation and hypothesis testing. Not available to Math majors for degree credit. Offered Every Term.
Prerequisites: MAT 1800 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Education.

MAT 6170 Algebra: Ring Theory Through Exploration, Conjecture, and Proof Cr. 4
Rings: basic definitions; properties; examples including the integers, rationals, reals, and complex numbers; ideals; homomorphisms; and divisibility. Connections to high school algebra. Students will be involved in the mathematical processes of exploration, conjecture, and proof. Offered irregularly.
Prerequisites: MAT 5000 with a minimum grade of C-

MAT 6180 Algebra: Group Theory Through Exploration, Conjecture, and Proof Cr. 3
Groups: basic definitions, properties, examples, subgroups, cyclic groups, permutation groups, homomorphisms, quotient groups. Connections to high school algebra. Students will be involved in the mathematical processes of exploration, conjecture, and proof. Offered Yearly.
Prerequisites: MAT 5000 with a minimum grade of C-

MAT 6200 Teaching Arithmetic, Algebra and Functions from an Advanced Perspective Cr. 3
Students gain profound understanding of K-12 mathematics. Concepts underlying K-12 topics and procedures; connections to higher mathematics. Teaching with Simplicity; applying mathematical understanding to teaching practices. Offered Yearly.
Prerequisites: MAT 5120 with a minimum grade of C- or MAT 6170 with a minimum grade of C- or MAT 6180 with a minimum grade of C-
Equivalent: MAE 6200

MAT 6210 Teaching Geometry, Probability and Statistics, and Discrete Mathematics from an Advanced Perspective Cr. 3
Historical perspectives, common conceptions and misconceptions, applications, technology, and mathematical connections relative to teaching geometry (including trigonometry), probability and statistics, and discrete mathematics in secondary school. Offered Yearly.
Equivalent: MAE 6210

MAT 6420 Advanced Linear Algebra Cr. 3
Prerequisites: MAT 5430 with a minimum grade of C-

MAT 6500 Topology I Cr. 3
Topological spaces and continuous functions; connectedness; compactness; product and quotient spaces; metric spaces; Urysohn’s lemma; Tietze extension theorem; homotopy; covering spaces and path lifting; the fundamental group and examples; Brouwer fixed point theorem and applications. Offered Yearly.
Prerequisites: MAT 5610 with a minimum grade of C-

MAT 6510 with a minimum grade of C-

MAT 6600 Complex Analysis Cr. 2-4
Complex differentiation; elementary functions; Cauchy’s integral theorem; power series; Laurent expansions; singularities; residue theorem; entire and meromorphic functions; Riemann mapping theorem. Offered Yearly.
Prerequisites: MAT 5610 with a minimum grade of C-

MAT 6830 Design of Experiments Cr. 3
Randomized blocks; Latin and Graeco-Latin squares; factorial designs; confounding; split plot; fractional replication; balanced incomplete blocks. Offered Irregularly.
Prerequisites: MAT 2250 with a minimum grade of C- or MAT 2150 with a minimum grade of C- or MAT 2210 with a minimum grade of C- or BE 2100 with a minimum grade of C- or ECO 5100 with a minimum grade of C- or PH 3200 with a minimum grade of C-
MAT 6840 Linear Statistical Models Cr. 3
Multivariate linear regression models, examples; least square estimates and system of normal equations; the Gauss-Markov theorem; hypothesis testing about regression coefficients; confidence intervals and regions; prediction; model selection, stepwise regression. Analysis of variances (ANOVA). Offered Biannually.
Prerequisites: MAT 5800 with a minimum grade of C

MAT 6990 Internship in Mathematical Sciences Cr. 1-3
Experience in industry, or in a research laboratory, or in an institution, using tools from the mathematics curriculum. Students provide a written report based on the internship experience. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students; enrollment is limited to students in the Department of Mathematics.
Repeatable for 3 Credits

Statistics
STA 1020 Elementary Statistics Cr. 3
Satisfies General Education Requirement: Quantitative Experience Comp
Descriptive statistics, correlation and regression, notions in probability, binomial and normal distributions, testing hypothesis. Offered Every Term.