Mathematics

0005 Intermediate Algebra (3)
Prerequisite: A satisfactory score on the university’s mathematics placement examination, obtained in the six months prior to enrollment in this course. Preparatory material for college level mathematics courses. Covers systems of linear equations and inequalities, polynomials, rational expressions, exponents, quadratic equations, graphing linear and quadratic functions. This course carries no credit towards any baccalaureate degree.

1020 Contemporary Mathematics (3)
Prerequisites: A satisfactory score on the university’s mathematics placement examination, obtained in the six months prior to enrollment in this course. Presents methods of problem solving, centering on problems and questions which arise naturally in everyday life. May include aspects of algebra and geometry, the mathematics of finance, probability and statistics, exponential growth, and other topics chosen from traditional and contemporary mathematics which do not employ the calculus. May be taken to meet the mathematical proficiency requirement, but may not be used as a prerequisite for other mathematics courses. Designed for students who do not plan to take Calculus. Credit will not be granted for Math 1020 if credit has been granted for Stat 1310, Math 1800, 1100, 1102, or 1105. Concurrent enrollment in Math 1020 and any of these courses is not permitted.

1030 College Algebra (3)
Prerequisites: A satisfactory score on the university’s mathematics placement examination, obtained in the six months prior to enrollment in this course. Topics in algebra and probability, polynomial functions, the binomial theorem, logarithms, exponentials, and solutions to systems of equations.

1035 Trigonometry (2)
Prerequisite: Math 1030 or concurrent registration, or a satisfactory ACT Math score, or a satisfactory score on the university's mathematics proficiency examination. A study of the trigonometric and inverse trigonometric functions with emphasis on trigonometric identities and equations.

1070 Applied Mathematics of Interest (2)
Prerequisites: Math 1030. An introduction to the role of interest in applied mathematics. Topics include simple and compound interest, mathematics of annuities, amortization bonds, sinking funds, and mortgages.

1100 Basic Calculus (3)
Prerequisite: Math 1030, or a satisfactory ACT Math score, or a satisfactory score on the university's mathematics proficiency examination. Introduction to plane analytic geometry and basic differential and integral calculus with application to various areas. No credit for Mathematics majors. Credit not granted for both Math 1800 and 1100.

1102 Finite Mathematics (3)
Prerequisite: Math 1030, or a satisfactory ACT Math score, or a satisfactory score on the university's proficiency examination. Introductory logic and set theory, partitions and counting problems, elementary probability theory, stochastic processes, Markov chains, vectors and matrices, linear programming, and game theory.

1105 Basic Probability and Statistics (3) [MS]
Prerequisites: Math 1030, or a satisfactory ACT Math score, or a satisfactory score on the university's mathematics proficiency examination. An introduction to probability and statistics. Topics include the concept of probability and its properties, descriptive statistics, discrete and continuous random variables, expected value, distribution functions, the central limit theorem, random sampling and sampling distributions. Credit not granted for more than one of Stat 1310, Stat 1320 and Math 1105.

1150 Structure of Mathematical Systems I (3)
Prerequisites: 45 hours of college credit and one of the following: Math 1030, a satisfactory ACT Math score, or a satisfactory score on the university's mathematics proficiency examination. A study of sets, relations, functions, whole numbers; the integers and their properties, and the rational and real number systems.
1310 Elementary Statistical Methods (3)
Prerequisite: Math 1030, or a satisfactory ACT Math score, or a satisfactory score on the university's mathematics proficiency exam. An introduction to the basic ideas and tools of statistics. Introductory data analysis, statistical modeling, probability and statistical inference. Includes topics in estimation, prediction, and hypothesis testing. A major focus of the course in the analysis of data using a computer software package such as SAS. A student may not receive credit for more than one of Statistics 1310, Statistics 1320, and Math 1105.

1320 Applied Statistics I (3)
Prerequisite: Math 1800 or 1100 or equivalent. This is the first course of a one-year sequence in introductory probability and statistics. It provides a comprehensive introduction to those models and methods which are most likely to be encountered by students in their careers in applied mathematics and the sciences. Topics include descriptive statistics, basics of probability theory, random variables and their distributions, sampling distributions, confidence intervals, and hypothesis testing for population means and population proportions. A student may not receive credit for more than one of Stat 1320, Stat 1310 and Math 1105.

1800 Analytic Geometry and Calculus I (5)
Prerequisites: Math 1030 and 1035, or a satisfactory ACT Math score along with a satisfactory score on the university's trigonometry examination, or a satisfactory score on both the university's mathematics proficiency examination and the university's trigonometry examination. This course provides an introduction to differential and integral calculus. Topics include limits, derivatives, related rates, Newton's method, the Mean-Value Theorem, Max-Min problems, the integral, the Fundamental Theorem of Integral Calculus, areas, volumes, and average values.

1900 Analytic Geometry and Calculus II (5)
Prerequisite: Math 1800. Topics include conic sections, rotations of axes, polar coordinates, exponential and logarithmic functions, inverse (trigonometric) functions, integration techniques, applications of the integral (including mass, moments, arc length, and hydrostatic pressure), parametric equations, infinite series, power and Taylor series.

2000 Analytic Geometry and Calculus III (5)
Prerequisite: Math 1900. Topics include vectors, cylindrical and spherical coordinates, vector-valued functions, arc length and curvature, functions of several variables, partial and directional derivatives, gradients, extrema, Lagrange multipliers, multiple integrals, change of variables, surface area, vector fields, Stokes' Theorem.

2020 Introduction to Differential Equations (3)
Prerequisite: Math 2000. Topics will be chosen from linear differential equations, equations with constant coefficients, Laplace transforms, power series solutions, systems of ordinary differential equations.

2320 Applied Statistics II (3)
Prerequisite: Math 1320, or equivalent. This course is a continuation of Stat 1320. It provides a survey of a variety of important statistical methods which are useful in analyzing data. Topics include single and multi-factor analysis of variance, simple and multiple linear regression, analysis of categorical data, and non-parametric statistical methods.

2450 Elementary Linear Algebra (3)
Prerequisites: Math 1100 or 1900. An introduction to linear algebra. Topics will include complex numbers, geometric vectors in two and three dimensions and their linear transformations, the algebra of matrices, determinants, solutions of systems of equations, eigenvalues and eigenvectors.

2510 Structure of Mathematical Systems II (3)
Prerequisite: Math 1150. An introduction to probability and statistics. An intuitive study of elementary geometry. Introduction to the deductive theory of geometry and to coordinate geometry.

3000 Discrete Structures (3)
Prerequisite: Math 1900 or 1100, and Cmp Sc 1250 or equivalent. Same as Cmp Sc 3000. Treats fundamental ideas in discrete structures and serves as a foundation for subsequent course in both Mathematics and Computer Science. Provides an introduction to techniques of mathematical reasoning.
with examples derived from computer science. Topics include logic, set algebra, equivalence relations and partitions, functions, mathematical induction, elementary number theory, cardinality, recurrence relations, basic combinatorial methods, trees and graphs. Credit not granted for more than one of Cmp Sc 3000, Math 250, and Math 3000

3520 Structure of Mathematical Systems III (3)
Prerequisite: Math 2510. Together with Math 1150 and 2510, this course teaches mathematics necessary for middle school mathematics certification. Topics from Math 1150 and 2510 are continued. Other topics include geometric constructions, similarity, coordinate geometry, normal distribution, combinatorics, and trigonometry. Credit will be granted only toward the B.S. in education degree in Early Childhood Education, Elementary Education, Middle School Education and Special Education.

4030 Applied Mathematics I (3)
Prerequisites: Math 2020 and 2450. Topics chosen from Fourier series, special functions, partial differential equations, and boundary value problems.

4060 Applied Differential Equations (3)
Prerequisite: Math 2020 and 2450. The study of ordinary differential equations and partial differential equations is continued with applications in such areas as physics engineering and biology.

4100 Real Analysis I (3)
Prerequisite: Math 2000 and 3000. Introduction to real analysis in one variable. Topics include the real number system, limits, continuity, differentiability, and sequences and series of functions.

4110 Advanced Calculus (3)
Prerequisite: Math 2000, 2450 and 3000. Multivariable analysis, inverse and implicit functions theorems, calculus on manifolds.

4160 Complex Analysis I (3)
Prerequisite: Math 2020 or both Cmp Sc/Math 3000 and Math 2000. Complex numbers and their geometrical representation, point sets, analytic functions of a complex variable, complex integration, Taylor and Laurent series, residue theorem, conformal mapping.

4200 Mathematical Statistics I (3)
Prerequisites: Math 1320 and Math 2000. Introduction to the theory of probability and statistics using concepts and methods of calculus.

4210 Mathematical Statistics II (3)

4230 Numerical Analysis I (3)
Prerequisites: Math 2020, 2450, and ability to program in an upper-level language. Solutions of equations, interpolation and approximation, numerical differentiation and integration, and numerical solution of initial value problems in ordinary differential equations. Selected algorithms will be programmed for solution on computers.

4240 Numerical Analysis II (3)
Prerequisite: Math 4230 or consent of instructor. Topics chosen from: the numerical solution of systems of linear equations; the eigenvalue/eigenvector problem; numerical solution of Partial Differential Equations (PDE); numerical solution of stiff Ordinary Differential Equations (ODE); boundary value problems; sparse matrix methods; approximation theory; optimization theory; digital filters; integral equations.

4260 Introduction to Stochastic Processes (3)
Prerequisite: Math 4200. Basic theory and applications of stochastic processes. Markov chains, martingales, recurrent and transient states, stationary distributions, ergodic theorem, renewal processes, discrete martingales and stationary processes.
4270 The Calculus of Variations (3)

4300 Multivariate Analysis (3)
Prerequisites: Math 2450 and Math 4200, or consent of instructor. Multivariate normal distribution and related sampling distributions. Procedures of statistical inference for the multivariate normal distributions, such as hypothesis testing, parameter estimations, multivariate regression, classification and discriminant analysis and principal components analysis.

4310 Analysis of Variance and Design of Experiments (3)
Prerequisites: Math 2450 and Math 4200 or consent of instructor. An introduction to the analysis of variance with applications in completely randomized designs, randomized block designs, factorial experiments and split-plot type designs.

4320 Regression Models in Statistics (3)
Prerequisites: Math 2320 or consent of instructor. A rigorous course focused on the applications of regression. The course is rigorous in that the basic regression models in one and several variables are carefully developed using matrix notation. Topics such as the extra sums of squares principle, the general linear hypothesis, and partial and sequential F-tests are carefully presented. The course will focus on using these tools to analyze many different data sets.

4330 Nonparametric Methods in Statistics (3)
Prerequisite: Math 4200 or consent of instructor. An introduction to nonparametric statistical procedures. Order statistics, rank order statistics and scores, tests of goodness of fit, linear rank tests for the location and scale problems and applications.

4350 Theory of Numbers (3)
Prerequisite: Cmp Sc/Math 3000 and Math 2000 or consent of instructor. Properties of integers, multiplicative functions, congruences, primitive roots, and quadratic residues.

4390 Topics in Probability and Statistics (3)
Prerequisite: Consent of instructor. A seminar on special topics in probability and statistics to be determined by the interests of the instructor. May be determined by the interests of the instructor. May be repeated for credit provided different topics are studied.

4400 Introduction to Abstract Algebra I (3)
Prerequisite: Cmp Sc/Math 3000 and Math 2000 or consent of the department. Introduction to groups, rings, and fields, with emphasis on groups and rings.

4410 Introduction to Abstract Algebra II (3)
Continuation of Math 4400 with emphasis on fields.

4450 Linear Algebra (3)
Prerequisites: Cmp Sc/Math 3000, Math 2000 and Math 2450. Topics selected from vector spaces, bases, linear transformations, matrices, canonical forms, eigenvalues, hermitian and unitary matrices, inner product spaces, and quadratic forms.

4500 Special Readings (1-10)
Prerequisites: Cmp Sc/Math 3000, Math 2000 and consent of instructor.

4550 Combinatorics (3)
Prerequisite: Cmp Sc/Math 3000 and Math 2000. Advanced counting methods are introduced, including the use of generating functions for the solution of recurrences and difference equations. Additional topics may include: graphs and trees, combinatorial designs, combinatorial games, error-correcting codes, and finite-state machines.

4580 Mathematical Logic (3)
Prerequisite: Cmp Sc/Math 3000 and Math 2000 or Philosophy 4460. A study of the logic of mathematics...
by the axiomatic method, with a development of the propositional calculus and restricted predicate calculus emphasizing its application to the foundations of mathematics.

4620 Projective Geometry (3)

4640 Introduction to Differential Geometry (3)

4660 Foundations of Geometry (3)
Prerequisite: Cmp Sc/Math 3000 and Math 2000 or consent of department. A development of portions of Euclidean geometry from a selected set of axioms, including a discussion of consistency, independence, categoricity, and completeness of the axioms.

4670 Introduction to Non-Euclidean Geometry (3)
Prerequisite: Cmp Sc/Math 3000 and Math 2000 or consent of the department. A summary of the history of the non-Euclidean geometries and a study of hyperbolic plane geometry.

4800 Introduction to Topology (3)
Prerequisite: Cmp Sc/Math 3000 and Math 2000 or consent of the department. A study of topological spaces, including the concepts of limit, continuity, connectedness, compactness, etc. Special emphasis placed on, and examples taken from, the space of real numbers.

4890 Topics in Mathematics (3)
Prerequisite: Consent of instructor. A seminar on special topics in mathematics to be determined by the interests of the instructor. May be repeated for credit provided different topics are studied.

5010 Theory of Ordinary Differential Equations (3)
Prerequisite: Math 4100. A theoretical treatment of ordinary differential equations including the existence and uniqueness of solutions of differential equations and systems of differential equations. The course treats such topics as systems of linear differential equations, eigenvalue problems, autonomous systems, and boundary value problems.

5020 Classical Applied Mathematics (3)
Prerequisites: Math 4100, 4160, and 4450 or consent of instructor. The course gives the derivation of equations of mathematical physics such as Navier-Stokes' equations, Euler's equations, equations of elastic materials, and equations of electrodynamics, using scaling and conservation principles. The course also includes elements of the calculus of variations, the Euler-Lagrange equations and Hamiltonian theory.

5040 Calculus of Variations (3)
Prerequisites: Math 2020, 4100 and 4450. Classical functionals, minimization of functionals, Euler-Lagrange equations, appropriate function spaces, weak solutions, existence of solutions, approximation theory, practical applications and finite element approach to solutions will be covered.

5050 Computational Curves and Surfaces (3)
Prerequisite: Math 4100, 4230 and 4450, or consent of instructor. Construction of curves and surfaces using subdivision algorithms. Iterative refinement of discrete data in an easily programmable manner. Discussion of issues of convergence, shape control, relation to spline functions with uniform knots, multi resolution analysis, and wavelets.

5060 Computational Harmonic Analysis (3)
Prerequisites: Math 4030, Math 4100, and Math 4450. The course covers the basic of Fourier analysis and wavelet analysis. Topics include Fourier transforms and series, discrete Fourier transform, discrete cosine transform ad their fast computational schemes, fast wavelet transform, and the lifting scheme. Additional topics include industrial standards for image compression and several aspects of signal processing.
5100 Real Analysis II (3)
Prerequisites: Math 4100. Introduction to measure and integration. Topics include the Riemann-Stieltjes integral, Lebesgue measure, measurable functions, the Lebesgue integral, Radon-Nikodym and Fubini theorems and the basics of Lp-spaces.

5110 Differentiable Manifolds (3)
Prerequisites: Math 4100, 4450, and 4800. An introduction to smooth manifolds and maps. Topics will include the Implicit Function Theorem, Sard's Theorem, transversality, intersection and degree theory, differential forms and integration on manifolds.

5140 Set Theory and Metric Spaces (3)
Prerequisites: Math 4100 or consent of instructor. Naïve set theory, cardinal arithmetic, ordinal numbers, the axiom of choice and equivalents, metric spaces, convergence, continuity, compactness, contraction principles and applications. Construction of completions and examples like the real numbers and p-adic numbers. Other topics could include the Stone-Weierstrass theorem and metrizability theorems.

5160 Complex Analysis II (3)
Prerequisites: Math 4160, and either Math 4100 or 4800. A second course in complex analysis, emphasizing the theory of analytic functions, and including various topics like the Riemann mapping theorem, normal families, analytic continuation, representations of analytic functions, and elliptic functions.

5270 Numerical Linear Algebra (3)
Prerequisite: Math 4230 and Math 4450 or consent of the instructor. The course includes solution of general and special linear systems. Techniques include methods such as splitting or Krylov subspaces. Additional topics are the eigenvalue problem and the method of least squares.

5300 Partial Differential Equations (3)
Prerequisites: Math 4100, 4160, 4450, and 4800. Classification of partial differential equations; Cauchy, Dirichlet, and Neumann problems; the fundamental solution; existence theorems of potential theory; eigenvalue problems; and Tricomi's problem.

5320 Applied Statistics (3)
Prerequisites: Math 4210 or consent of instructor. The course studies classical and recently developed statistical procedures selected from areas including analysis of variance, multivariate analysis, nonparametric or semiparametric methods and generalized linear models. Emphasis is on application of procedures, including the rationale underlying choice of procedures.

5350 Operations Research-Deterministic Models (3)
Prerequisites: Math 4450 or equivalent. A study of deterministic methods and models in operations research. This course provides an introduction to operations research and focuses on model building, solution and interpretation of results. Topics include formulation, solution, duality and sensitivity analysis in linear programming, integer programming, network flow models, nonlinear optimization, and dynamic programming.

5360 Operations Research-Stochastic Models (3)
Prerequisites: Math 4200 or equivalent. A study of stochastic methods and models in operations research. Provides an introduction to probabilistic models for decision making under uncertainty. Topics include stochastic processes, queuing theory and models, probabilistic inventory theory and models, Markovian decision problems, simulation and reliability.

5370 Quality Management (3)
Prerequisite: Math 4200 or consent of instructor. An applied course on total quality management. Quality improvement approaches are presented and the managerial implications and responsibilities in implementing these approaches are discussed. Topical coverage includes the construction and interpretation of control charts, graphical methods, quality function deployment, robust experiments for product design and improvement, mistake-proofing (poke-yoke), the Deming approach, Baldrige award criteria, quality cost audits, worker empowerment and reward systems. Cases involving both business processes and physical processes are used to illustrate successful quality improvement efforts.
5420 Algebra (3)
Prerequisites: Math 4400 and 4450. Basic fundamentals of the theory of groups, rings and fields.

5500 Directed Readings (1-6)
Prerequisite: Consent of instructor. Independent readings at an advanced level.

5550 Topics in Advanced Mathematics for the Teacher (3)
Prerequisite: Consent of instructor. This course will look at various topics in algebra, analysis, and geometry that will deepen a teacher’s understanding of the mathematics of the precollegiate curriculum. It can be taken more than once for credit.

5600 Topics in Computation (3)
Prerequisite: Consent of instructor. The course will cover various advanced topics in computation and can be taken more than once for credit. Examples of such topics are: computer graphics, computer architecture, theories of language, analysis of operating systems, numerical geometry and computer aided design, etc.

5700 Topics in Applied Mathematics (3)
Prerequisite: Consent of instructor. This course will cover various advanced topics in applied mathematics, and can be taken more than once for credit. Examples of such topics are: Fast transforms, digital filters, etc.

5710 Topics in Analysis (3)
Prerequisite: Math 5100 or consent of instructor. Topics selected from the areas of Fourier analysis, harmonic analysis, functional analysis, special functions, generalized functions, and partial differential equations. May be taken more than once for credit with consent of department.

5720 Topics in Numerical Analysis (3)
Prerequisite: Consent of instructor. The course will cover various advanced topics in numerical analysis and can be taken more than once for credit. Examples of such topics are: A.D.I. Techniques for solving p.d.e., finite element techniques, the algebraic eigenvalue problem, the software, etc.

5800 Topics in Topology (3)
Prerequisite: Consent of instructor. The course will cover topics selected from algebraic or differential topology and may be taken more than once for credit with the consent of the department.

5810 Topics in Number Theory (3)
Prerequisite: Consent of instructor. Topics selected from elementary, algebraic, analytic, and other branches of number theory. Examples of topics include the distribution of primes, the Riemann Zeta function, averages of arithmetic functions, the theory of partitions, ideal theory, and representations of integers by quadratic forms.

5820 Topics in Algebra (3)
Prerequisite: Consent of instructor. Topics selected from the theory of groups, rings, fields, algebras, and other algebraic systems. May be taken more than once for credit with consent of department.

6070 Time-Frequency Analysis (3)
Prerequisites: Math 5060. The course covers theoretical and practical aspects of several time-frequency methods. Included are linear transformations such as filtering, Zak, Gabor and wavelet transforms; bilinear transformations include the Winger-Ville distribution and other distributions of Cohen’s class. Statistical methods of feature extraction and applications to signal compression are outlined as well.

6080 Advances in Wavelet Analysis (3)
Prerequisite: Math 5060. The course describes recent developments in several research areas connected with wavelet analysis. Included are frames, wavelet vectors, wavelet packets, wavelets on compact intervals and manifolds, adaptive (nonlinear) methods, and methods of computational physics. Applications include the sparsification of matrices, denoising and compression of signals.
**6200 Probability Theory (3)**
Prerequisite: Math 5100 may be taken concurrently. Combinatorial analysis, random walks, stochastic independence, random variables, laws of large numbers, generating functions, and branching processes.

**6440 Lie Groups (3)**
Prerequisites: Math 4400 and 5110. The course provides an introduction to Lie Groups, Lie Algebras, and their representations.

**6600 Topics in Probability Theory (3)**
Prerequisite: Consent of instructor. The course will cover advanced topics in probability theory and may be taken more than once for credit with the consent of the department.

**6700 Functional Analysis (3)**
Prerequisites: Math 4450 and 5100. Algebraic and topological tools applied to problems in analysis. The topics chosen will usually include topological vector spaces, metric spaces, Banach spaces, Hilbert spaces, and Banach algebras.

**6900 Master's Thesis (1-6)**
Prerequisite: Consent of instructor. Thesis work under the supervision of a faculty member. The course is designed for those students intending to present a thesis as part of their M.A. program. Students who do not write a thesis cannot apply Math 6900 to a degree.

**7990 Ph.D. Dissertation Research (1-9)**
Prerequisites: Completion of comprehensive exams. May be taken for no more than nine hours.