MATHEMATICS (MATH)

MATH1000 COLLEGE MATHEMATICS
Algebra and trigonometry, including algebraic fractions, systems of linear equations, quadratic equations, literal equations, word problems and their solutions, right triangles, and vectors. Applications will be stressed. (4 credits) fall, spring

MATH1020 PLANE & SOLID GEOMETRY
A survey of elementary Euclidean geometry including lines and angles, measurement and units, properties of triangles, parallelograms, trapezoids, regular polygons, circles, conic sections, spheres, cylinders, pyramids, polyhedra, areas, and volumes. (4 credits) spring

MATH1030 STATISTICS & APPLICATIONS
This course is designed to introduce students to statistical concepts relating to engineering design, inspection, and quality assurance. Topics covered include probability, normality, sampling, regression, correlation, and confidence intervals in reliability. (4 credits) fall, spring

MATH1040 APPLIED MATHEMATICS FOR BUSINESS
The purpose of this course is to provide students with the basic math skills useful in solving real-life business problems. Linear and quadratic equations will be studied and applied to finance and social sciences. Functions and graphs will be studied and applied to the basic data analysis. Systems of linear equations and linear programming will be applied to maximizing profit. An introduction to probability and statistics and basic financial mathematics are provided. (4 credits) fall

MATH1500 PRECALCULUS
Topics include: polynomial and rational functions, exponential and logarithmic functions, trigonometric functions, parametric equations, analytic trigonometry, multivariable systems, and applications and modeling. ***Prerequisite:*** *MATH1000 or MATH Placement (4 credits) fall, spring, summer*

MATH1525 FOUNDATIONS OF CALCULUS
This course is focused on preparing students for successful completion of the calculus sequence. The topics include function inverses and compositions, identifying and graphing the library of functions, solving linear, quadratic, exponential, logarithmic, and trigonometric functions, simplifying rational expressions, and determining function behavior. ***Prerequisites:*** *MATH1000. (4 credits) fall*

MATH1550 FOUNDATIONS OF APPLIED MATHEMATICS
Problems, methods, and recent developments in applied mathematics will be discussed. Topics include, but are not limited to, the following: difference equations, fitting models to data and choosing a best model, probabilistic models, sequential decisions and conditional probability and game theory. Students will gain familiarity with technical word processors such as LaTeX, spreadsheet software and also with high level programming packages such as python, R, and MATLAB. Students will also hear guest speakers describe the role that mathematics plays in their respective careers. (4 credits) fall

MATH1600 MATH ESSENTIALS FOR CALCULUS
This course reviews algebra and precalculus skills as they appear in calculus. Topics include solving equations involving linear, quadratic, exponential, and trigonometric functions, as well as manipulating these functions and graphing them. The course also covers simplifying rational expressions. This is a seven-week course. (2 credits)

MATH1750 ENGINEERING CALCULUS I
Limits, continuity, differentiability, the limit definition of the derivative, differentiation, linearization and some integration of algebraic and transcendental functions, implicit differentiation. Intended for engineering majors or advanced technology students. (4 credits) fall, spring, summer

MATH1776 CALCULUS 1A
This course covers the computation of limits. Additionally, it covers rates of change as one of the fundamental calculus concepts and emphasizes the conceptual derivation of derivatives using limits, as well as skill building with basic differentiation rules. This is a seven-week course. (2 credits) fall, spring

MATH1777 CALCULUS 1B
This course builds on knowledge of basic derivatives and covers additional rules such as implicit differentiation and derivatives of inverse trigonometric functions. The course covers graphical interpretation of derivatives, as well as applications of derivatives, including related rates and optimization. The concepts of antiderivatives and accumulation are also introduced. This is a seven-week course. ***Prerequisite:*** *MATH1776 (2 credits) fall, spring, summer*

MATH1875 INTEGRATED ENGINEERING CALCULUS II
Define integrals as a limit of Reimann sums, computation of definite and indefinite integrals using the techniques of integration, improper integrals, convergence of sequences and series, including Taylor series. Integrates symbolic tools, graphical concepts, data and numerical calculations. Students will model engineering and scientific problems in lecture and lab. ***Prerequisite:*** *MATH1775 (4 credits)*

MATH1876 CALCULUS 2A
This course covers the fundamental theorem of calculus along with methods of integration, including substitution, integration by parts, and integration with partial fraction decomposition. This course also discusses geometric applications of integrals in a single variable and the application of integration to solving real-world problems. This is a seven-week course. ***Prerequisite:*** *MATH1777 or MATH1750 (2 credits) fall, spring, summer*

MATH1877 CALCULUS 2B
This course solidifies the basic calculus competencies from integral and differential calculus while building on the relations between them, including discussion of initial value problems and Taylor series. This is a seven week course. ***Prerequisites:*** *MATH1777 or MATH1750 and MATH1876 (2 credits) fall, spring*

MATH1900 INTRODUCTION TO OPERATIONS RESEARCH
This course serves as an introduction to the field of operations research (OR). The course will cover basic deterministic (non-probabilistic) methods of operations research (linear programming, network flows, and integer programming) and their applications to resource allocation problems in business and networking. ***Prerequisite:*** *MATH1500 or MATH1525 or MATH2800 (4 credits) summer*

MATH1950 FINANCIAL MATHEMATICS
This course is designed to prepare students for the Society of Actuaries Exam FM (Financial Mathematics) This course will develop knowledge of the fundamental concepts of financial mathematics and how these concepts are applied in the time of value of money, loans, bonds and general cash flows and portfolios. General theories of interest such as annuities, yield rates, and amortization will be covered. Bonds and other securities and additional topics in financial analysis such as determining interest rates and interest rate swaps will be covered. ***Prerequisites:*** *MATH1800, MATH1850, MATH1877 or MATH1875 (4 credits)*

MATH2025 MULTIVARIABLE CALCULUS
Three dimensional Cartesian coordinate system, vectors, lines in three dimensions, planes and other surfaces, partial derivatives, directional derivatives, local extrema, polar coordinates, and multiple integrals in Cartesian and polar coordinates, vector fields, line integrals, and Green's Theorem. *Prerequisite: MATH1850, MATH1877 or MATH1875 (4 credits) fall, spring, summer*

MATH2100 PROBABILITY & STATISTICS FOR ENGINEERS
Topics studied are basic probability and a variety of probability distributions used in engineering modeling and reliability (expected life of products); linear regression and correlation; and hypothesis testing. *Prerequisite: MATH1800 or MATH1850, MATH1877 or MATH1875 (4 credits) fall, spring, summer*

MATH2200 ADVANCED STATISTICS
Topics include: design of experiments, correlation and regression, analysis of variance, t-tests, nonparametric methods, failure, mode, and effects analysis. *Prerequisite: MATH2100 (4 credits) spring*

MATH2250 TIME SERIES
The course will provide a basic instruction to time series. Topics include time series regression and exploratory data analysis, ETS, MA, ARMA/ARIMA models, parameter estimate, model diagnostics, seasonal models and forecasting. *Prerequisite: MATH2100 (4 credits) fall*

MATH2300 DISCRETE MATHEMATICS
Topics of this course to be chosen from: elementary logic, sets, permutations and combinations, induction, relations, digraphs, functions, trees, Warshall's Algorithm, and Boolean algebra. (4 credits) fall, spring, summer

MATH2500 DIFFERENTIAL EQUATIONS
Introduction to the solution of ordinary differential equations (ODEs). Topics will include solving first and higher order ODEs with constant coefficients, simple matrix equations and systems of ODEs, applications, and Euler's and Laplace transform solution methods. *Prerequisite: MATH1850 or MATH1877 or MATH1875 (4 credits) fall, spring, summer*

MATH2550 TRANSITION TO ADVANCED MATH
Students will review elementary logic and earn standard proof techniques: direct proof, proof by contradiction, contraposition, cases and induction. Students will write proofs of statements related to sets, relations, functions. Quantifiers, set operations, equivalent forms of mathematical induction, equivalence relations, partitions, graphs of relations, surjections, injections and cardinality will be discussed. *Prerequisite: MATH2300 (4 credits) spring*

MATH2600 DIFFERENTIAL EQUATIONS & LINEAR SYSTEMS
This course is an introduction to ordinary differential equations (ODEs) and linear algebra. Topics include first- and higher-order ODEs with constant coefficients, Euler's and Laplace transform solution methods, systems of linear equations and ODEs, row reduction of matrices, determinants, and linear independence. *Prerequisites: MATH1877 or MATH1850 or MATH1875. (4 credits) fall*

MATH2800 FINITE MATH
Set theory and logic, matrix notation and manipulation, linear programming and simplex method are studied. An introduction to probability and statistics is provided. Problem-solving by computer. *Prerequisite: MATH1000 (4 credits) spring*

MATH2860 LINEAR ALGEBRA & MATRIX THEORY
Topics include the basic operations of n-tuples and matrices, geometric vectors, equations of lines and planes, systems of linear equations, row reduction of matrices, linear independence, determinants, and an introduction to basis, dimension, eigenvalues, eigenvectors, and vector spaces. *Prerequisite: MATH1850 or MATH1877 (4 credits) fall, spring*

MATH3100 MEDICAL IMAGING: A MATHEMATICAL APPROACH
This course will provide basic mathematical foundations for medical imaging. There will be emphasis on both theoretical background and numerical methods to implement inversion algorithms. Topics include, but are not limited to: Radon and Fourier transforms, convolution, sampling, filters, and image reconstructions. *Prerequisite: MATH2025 (4 credits)*

MATH3700 OPERATIONS RESEARCH
An introduction to operations research, with topics chosen from linear programming (covering formulation of a number of different types of linear models, the simplex algorithm, duality and sensitivity analysis, the transportation and assignment problems, and integer linear programming).Network models, constrained optimization, modeling and simulation, and game theory are also discussed. *Prerequisite: MATH2860 (4 credits) fall*

MATH3800 SPECIAL TOPICS IN APPLIED MATHEMATICS
Presents topics that are not covered by existing courses and are likely to change from semester to semester. Refer to the Class Schedule for a specific semester for details of offerings for the semester. (1 - 4 credits)

MATH3900 NUMERICAL ANALYSIS I
Analysis of algorithms frequently used in mathematics, the sciences, engineering and industry. Topics include: root-finding, interpolation, linear systems, numerical differentiation and integration, solution of initial value problems. Numerical experiments will be conducted with C, Matlab, Java, Python or another appropriate high-level language. *Prerequisites: COMP1000 and MATH1850 (4 credits) fall*

MATH4050 MACHINE LEARNING
Introduction to the field of machine learning. This course focuses on algorithms to help identify patterns in data and predict or generalize rules from these patterns. Topics include supervised learning (parametric/non-parametric algorithms, kernels, support vector machines), model selection, and applications (such as speech and handwriting recognition, medical imaging, and drug discovery). Students who have basic programming skills and who have taken a course in probability are encouraged to take this course. Cross-list with COMP4050 *Prerequisite: COMP1000 and MATH2100 (4 credits)*

MATH4100 INDUSTRIAL PROBLEMS IN APPLIED MATHEMATICS
This is an applied problems course in mathematics. Students will work in small teams to solve problems arising in industry under the guidance of the course professor and an industrial liaison. Every term will be different. (4 credits)

MATH4400 INTRODUCTION TO ABSTRACT ALGEBRA
Topics include groups, subgroups, and factor groups, homomorphisms, rings and fields, and applications that may include symmetry groups, frieze groups, and crystallographic groups and/or introductions to algebraic coding theory. This course is recommended for students intending to go to graduate school for mathematics or a mathematics-related discipline. *Prerequisite: MATH2300 (4 credits)*

MATH4475 ACTUARIAL MATHEMATICS
This course is designed to prepare students for the Society of Actuaries' exam P/CAS Exam 1. We will develop knowledge of the fundamental probability tools for quantitatively assessing risk with an emphasis on problems encountered in actuarial science. ***Prerequisite:** MATH2100 completed with a grade of B or better (4 credits)*

MATH4575 COMPLEX VARIABLES
Topics in this course include complex algebra and functions; analyticity; contour integration, Cauchy's theorem; signatures. Taylor and Laurent series; residues, evaluation on integrals; multivalued functions, potential theory in two dimensions. ***Prerequisites:** MATH2025 (4 credits)*

MATH4875 REAL ANALYSIS I
Introduction to real analysis. Topics include introductory proof writing, the real number system, limits, continuity, properties of real-valued functions, differentiation and elementary theory of integration. ***Prerequisite:** MATH2025 (4 credits)*

MATH4900 PARTIAL DIFFERENTIAL EQUATIONS
An introductory course in partial differential equations which covers the methods of characteristics, separation of variables, Fourier Series, finite differences, Fourier Transforms and Green's Functions. ***Prerequisite:** MATH2500 (4 credits) fall*

MATH4950 DYNAMICAL SYSTEMS AND CHAOS
Introduction to dynamical systems and chaos with emphasis on applications in science and engineering. Topics include one-dimensional flows (fixed points, stability and bifurcations), two-dimensional flows (phase planes, limit cycles, and bifurcations), and chaos (lorenz equations, maps, fractals and strange attractors). This course counts as a technical elective for applied mathematics majors and minors. ***Prerequisite:** MATH2500 (4 credits)*

MATH5000 APPLIED MATHEMATICS FINAL YEAR DESIGN I
Student will work alone and in small group projects to study, analyze, design, and sometimes build and test concepts in an applied mathematics subfield of their choosing. The study will be performed under the direction of one or more faculty advisors. Projects from industry be encouraged to increase the interaction and cooperation with firms. Course requirements include regular oral and written progress reports throughout the semester. The final technical report by students may include a plan for the following Applied Mathematics Final Year Design II course. ***Prerequisite:** Final year standing in BSAM program (4 credits) fall*

MATH5100 STATISTICAL THINKING
Building upon a foundation of Advanced Statistics, this course introduces a rich repertoire of statistical tools essential for modeling and deciphering complex datasets. Moreover, participants will delve into the world of Bayesian analysis to embrace a more nuanced approach in drawing meaningful statistical inferences. The course also guides students to construct modeling algorithms that can be applied to real-world datasets, ensuring a practical and skill-oriented educational experience. (4 credits)

MATH5200 METHODS OF CALCULUS
This course is a gateway course into the MSACS program. Topics include limits, integrals, derivatives, numerical derivatives, numerical integrals, Sequences, Series, Taylor series, Newton's method, Lagrange polynomials, Hermite polynomials, steepest ascent/descent, vectors, matrices, eigenvalues, and eigenvectors. (4 credits) fall

MATH5500 APPLIED MATHEMATICS FINAL YEAR DESIGN II
This course is a continuation of Applied Math Final Year Design I. Students will continue with their design and analysis (or with new designs and analysis) with emphasis on improvements and applications. Other faculty and local industry professionals will review the student work and make recommendations. (4 credits) summer

MATH5700 MATHEMATICS FOR MACHINE LEARNING
This course prepares students with additional mathematics needed to succeed in a variety of computational disciplines. Topics include linear algebra, matrix decompositions, multivariable calculus, and optimization. (3 credits) fall

MATH5750 APPLIED STATISTICS
This course introduces students to the tools used for statistical and probabilistic analysis. The focus is on the basics of probability, regressions models, hypothesis testing, and understanding the use and interpretation of output data with attention to applications in artificial intelligence. ***Prerequisites:** MATH5200 (4 credits) spring*

MATH5800 MATHEMATICAL METHODS
This course provides the necessary analytical and numerical background for graduate students in engineering and sciences. Topics include error-bound, truncation method, least square regression for linear and polynomial models, linear algebra and matrix theory, ordinary differential equations (ODE), partial differential equations (PDE), Fourier transform, and discrete Fourier Transform. The expected background of students is knowledge of ordinary differential equations. (3 credits)

MATH6100 STATISTICS FOR RISK MODELING
This actuarial course provides in-depth coverage of the theory and practical applications of various statistical models and prepares students for the Society of Actuaries (SOA) sequence exams. The course delves into the fundamental concepts and techniques of linear regression models, generalized linear models, tree-based models, and regression-based time series models. Emphasis is placed on mastering key aspects such as parameter estimation, statistical inference, prediction, variable selection, and diagnostic checking within the context of these models. To enhance practical understanding, the course incorporates hands-on experience with real data in actuarial and financial settings with the help of statistical software tools. (3 credits) fall

MATH7800 GRADUATE SPECIAL TOPICS IN APPLIED MATHEMATICS
Presents topics that are not covered by existing courses and are likely to change from semester to semester. Refer to the Class Schedule for a specific semester for details of special topics course offerings. (4 credits)