MAT 122-C Overview of Calculus with Applications
The basics of calculus in a self-contained, one-semester course. Properties and applications of polynomial, exponential, and logarithmic functions. Derivatives: slopes, rates of change, optimization, integrals, area, cumulative change, and average. The fundamental theorem of calculus. Emphasis on modeling examples from economics. Students who subsequently wish to enroll in MAT 125 or 131 will be required to take MAT 130 as a pre- or corequisite to either course or to score level 4 on the mathematics placement examination before taking either course. 
Prerequisite: MAP 103 or level 3 on the mathematics placement exam
Prerequisite must be met within one year prior to beginning the course.
3 credits

MAT 123-C Introduction to Calculus
Prerequisite: MAP 103 or level 3 on the mathematics placement exam
Prerequisite must be met within one year prior to beginning the course.
3 credits

MAT 125-C Calculus A
Differential calculus, emphasizing conceptual understanding, computations and applications, for students with minimal background from 12th-year high school mathematics. Differentiation of elementary algebraic functions, algebraic, exponential, and logarithmic functions, graphs, modeling, and maximization. May not be taken for credit in addition to MAT 131 or AMS 151.
Prerequisites: C or higher in MAT 125; or level 4 on the mathematics placement examination; or MAT 122 and coregistration in MAT 130
3 credits

MAT 126-C Calculus B
A continuation of MAT 125, covering integral calculus, the fundamental theorem, symbolic and numeric methods of integration, area under a curve, volume, applications such as work and probability. May not be taken for credit in addition to MAT 125 or 171 or AMS 161.
Prerequisite: C or higher in MAT 125 or 131 or 141 or AMS 151 or level 6 on the mathematics placement examination
3 credits

MAT 127-C Calculus C
A continuation of MAT 126, covering: improper integrals and the hospital’s rule, complex numbers, sequences, series, Taylor series, differential equations, and modeling. May not be taken for credit in addition to MAT 132 or 142 or 171 or AMS 161. 
Prerequisite: C or higher in MAT 126 or level 8 on the mathematics placement examination
3 credits

MAT 130 Functions
Inverse functions, exponential and logarithmic functions, radian measure of angles and trigonometric functions. Open to prospective students in engineering, physical sciences, and mathematics who need to bridge the gap between MAT 122 and 125 or 131 or AMS 151. May not be taken for credit in addition to MAT 125.
Advisory Prerequisite: C or higher in MAT 122
Advisory Corequisite: MAT 125 or 131 or AMS 151
1 credit

MAT 131-C Calculus I
The differential calculus and integral calculus, emphasizing conceptual understanding, computations, and applications, for students who have the necessary background from 12th-year high school mathematics. Differentiation of elementary algebraic, trigonometric, exponential, and logarithmic functions; graphs, modeling, and maximization; the Riemann integral; and the fundamental theorem. May not be taken for credit in addition to MAT 125 or 141 or AMS 151.
Prerequisite: B or higher in MAT 123, or level 5 on the mathematics placement examination, or B or higher in MAT 122 and coregistration in MAT 130
4 credits

MAT 132-C Calculus II
A continuation of MAT 131, covering symbolic and numeric methods of integration; area under a curve; volume; applications such as work and probability; improper integrals and the hospital’s rule; complex numbers; sequences; series; Taylor series; differential equations; and modeling. May not be taken for credit in addition to MAT 127 or 142 or 171 or AMS 161.
Prerequisite: C or higher in AMS 151 or MAT 126 or MAT 131 or 141, or level 7 on the mathematics placement examination
4 credits

MAT 141-C Honors Calculus I
The topics of MAT 131 treated with additional attention to the underlying theory as a means of understanding the processes of calculus work. May not be taken for credit in addition to MAT 125 or 131.
Prerequisite: Level 5 on the mathematics placement examination; priority given to students in the University’s honors programs
4 credits

MAT 142 Honors Calculus II
A continuation of MAT 141 in the same spirit, covering the topics of MAT 132. May not be taken for credit in addition to MAT 126 or 127 or 132 or 171 or AMS 161.
Prerequisite: C or higher in MAT 141, or B or higher in MAT 131 or AMS 151, or level 7 on the mathematics placement examination
4 credits

MAT 160 Mathematical Problems and Games
Intended for students interested in sharpening their problem-solving skills and in developing their ability to express mathematical ideas.
1 credit, S/U grading

MAT 171-C Accelerated Single-Variable Calculus
A single semester, honors-level, course which reviews the material in MAT 131 in a few weeks, then concentrates on the topics covered in MAT 132, with additional attention paid to the underlying theory. Primarily intended for students who have had calculus in high school. May not be taken for credit in addition to MAT 126 or 127 or 132 or 142 or AMS 161.
Prerequisites: Level 5 on the AB Calculus AP exam, Level 3 on the BC Calculus exam, A or A- in MAT 131 or AMS 151, MAT 141, or level 7 on the mathematics placement exam. Priority given to students in the University’s honors programs.
4 credits

MAT 200 Logic, Language and Proof
A basic course in the logic of mathematics, the construction of proofs, and the writing of proofs. The mathematical content is primarily set theory, combinators, and Euclidean geometry. There is considerable emphasis on writing.
Prerequisites: C or higher in MAT 203 or 205 or AMS 261 and in MAT 211 or AMS 210, or A or higher in MAT 125 or 131 or 141 or AMS 151; or B- or higher average in MAT 125/126/127 or MAT 131/132 or MAT 141/142 or AMS 151/161 or MAT 171; or permission of instructor
3 credits

MAT 203 Calculus III with Applications
Vector algebra in two and three dimensions, multivariate differential and integral calculus, optimization, ordinary differential equations, and an introduction to modeling. 
Prerequisite: C or higher in MAT 127 or 132 or 142 or 171 or AMS 161 or level 9 on the mathematics placement examination
Pre or Corequisite: MAT 211 or AMS 210
3 credits

MAT 205 Calculus III
Vector algebra, multivariate differential and integral calculus, divergence and curl, line and surface integrals, theorems of Green, Gauss, and Stokes. Multiple integration, optimization, vector fields, and vector calculus in general coordinates. 
Prerequisite: C or higher in MAT 127 or 132 or 142 or 171 or AMS 161 or level 9 on the mathematics placement examination
Pre or Corequisite: MAT 211 or AMS 210
3 credits

MAT 211 Introduction to Linear Algebra
Introduction to the theory of linear algebra with some applications: vectors, vector spaces, bases and dimensions, applications to geometry, linear transformations and rank, eigenvalues and eigenvectors, determinants and inner products. May not be taken for credit in addition to AMS 210.
Prerequisite: C or higher in AMS 151 or MAT 131 or 141 or coregistration in MAT 129 or level 7 on the mathematics placement examination
3 credits

MAT 260 Problem Solving in Mathematics
Students actively solve challenging problems in plane geometry, basic number theory, and calculus, and write precise arguments. Relevant preparation for problem-solving is provided in the course.
Prerequisite: MAT 203 or 205 or AMS 261, or B or higher in MAT 127 or 132 or 142 or AMS 151
1 credit

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COURSE DESCRIPTIONS
MAT 303 Calculus IV with Applications
Homogeneous and inhomogeneous linear differential equations; systems of linear differential equations; series solutions; Laplace transforms; introduction to wave, heat, and Laplace equations; Fourier series. Applications to economics, engineering, and all sciences with emphasis on numerical and graphical solutions; use of computers. May not be taken for credit in addition to AMS 361 or MAT 305.
Prerequisite: C or higher in MAT 127 or 132 or 142 or 171 or AMS 161 or level 9 on the mathematics placement examination
3 credits

MAT 305 Calculus IV
Linear versus nonlinear equations and their numerical solutions, existence and uniqueness, Duhamel’s principle for linear equations, series solutions, systems. Introduction to wave, heat, and Laplace equations; Fourier series; comparison of separation of variables with integral formulas. More theoretical than MAT 303. Applications to the physical sciences. May not be taken for credit in addition to MAT 303 or AMS 361.
Prerequisite: C or higher in MAT 127 or 132 or 142 or 171 or AMS 161 or level 9 on the mathematics placement examination
3 credits

MAT 310 Linear Algebra
Finite dimensional vector spaces, linear maps, dual spaces, bilinear functions, inner products. Additional topics such as canonical forms, multilinear algebra, numerical linear algebra.
Prerequisites: C or higher in MAT 211 or 305 or AMS 210; C or higher in MAT 200 or permission of instructor
3 credits

MAT 311 Number Theory
Congruences, quadratic residues, quadratic forms, continued fractions, Diophantine equations, number-theoretical functions, and properties of prime numbers.
Prerequisites: C or higher in MAT 312 or 313 or 318; C or higher in MAT 200 or permission of instructor
3 credits

MAT 312 Applied Algebra
Topics in algebra: groups, informal set theory, relations, homomorphisms. Applications: error correcting codes, Burnside’s theorem, computational complexity, Chinese remainder theorem. This course is offered as both AMS 263 and MAT 312.
Prerequisite: C or higher in AMS 210 or MAT 211
Advisory Prerequisite: MAT 200 or CORE 113
3 credits

MAT 313 Abstract Algebra
Groups and rings together with their homomorphisms and quotient structures. Unique factorization, polynomials, and fields.
Prerequisites: C or higher in MAT 310 or 312 or 318; C or higher in MAT 200 or permission of instructor
3 credits

MAT 316 Invitation to Modern Mathematics
Mathematical reasoning and the process of mathematical research. The power and range of modern mathematics are discussed in detail through a few key theorems in algebra, analysis, geometry, and topology together with some applications.
Prerequisites: MAT 211 or AMS 210; MAT 203 or 205 or AMS 261; MAT 200 or permission of instructor
3 credits

MAT 318 Classical Algebra
Re-examines algebra from an historical perspective: the Hindu-Arabic number system; mathematics in ancient Egypt and China; the Greek contribution (unique factorization, Euclidean division algorithm, polynomials); unsolvability of the three great problems (trisecting the angle, squaring the circle, solving quintics); modern perspectives.
Prerequisites: C or higher in the following: MAT 125 or 131 or 141 or AMS 151; MAT 211 or AMS 210; MAT 200 or permission of instructor
Advisory Prerequisite: MAT 125 or 131
3 credits

MAT 319 Foundations of Analysis
A careful study of the theory underlying topics in one-variable calculus, with an emphasis on those topics arising in high school calculus. The real number system. Limits of functions and sequences. Differentiations, integration, and the fundamental theorem. Infinite series.
Prerequisites: C or higher in MAT 200 or permission of instructor; C or higher in one of the following: MAT 203, 205, 211, AMS 261, or A or higher in MAT 127, 132, 142, 171, or AMS 161
3 credits

MAT 320 Introduction to Analysis
Prerequisites: C or higher in MAT 200 or permission of instructor; C or higher in one of the following: MAT 203, 205, 211, AMS 261, or A or higher in MAT 127, 132, 142, 171, or AMS 161
3 credits

MAT 322 Analysis in Several Dimensions
Continuity, differentiation, and integration in Euclidean n-space. Differentiable maps. Implicit and inverse function theorems. Differential forms and the general Stokes’s theorem.
Prerequisites: C or higher in MAT 203, 205, or AMS 261; C or higher in MAT 211 or AMS 210; B or higher in MAT 320
Advisory Pre- or Corequisite: MAT 310
3 credits

MAT 324 Real Analysis
Prerequisites: C or higher in MAT 205 or 205 or AMS 261; B or higher in MAT 320
3 credits

MAT 331 Computer-Assisted Mathematical Problem Solving
Exploration of the use of the computer as a tool to gain insight into complex mathematical problems through a project-oriented approach. Students learn both the relevant mathematical concepts and ways that the computer can be used (and sometimes misused) to understand them. The particular problems may vary by semester; past topics have included cryptography, fractals and recursion, modeling the flight of a glider, curve fitting, the Brachistochrone, and computer graphics. No previous experience with computers is required.
Prerequisite: C or higher in MAT 203 or 205 or AMS 261
3 credits

MAT 336-H History of Mathematics
A survey of the history of mathematics from the beginnings through the 19th century, with special attention to primary sources and to the interactions between culture and mathematics. Emphasis on topics germane to the high school curriculum. Mesopotamian, Egyptian, and Greek mathematics; non-European mathematics; early Renaissance mathematics; the birth and flowering of calculus; the beginnings of probability theory; and the origin of non-Euclidean geometries and the modern concept of number.
Prerequisite: MAT 200 or AMS 301
3 credits

MAT 341 Applied Real Analysis
Partial differential equations of mathematical physics: the heat, wave, and Laplace equations. Solutions by techniques such as separation of variables using orthogonal functions (e.g., Fourier series, Bessel functions, Legendre polynomials). D’Alembert solution of the wave equation.
Prerequisites: C or higher in the following: MAT 203 or 205 or AMS 261; MAT 303 or 305 or AMS 361
Advisory Prerequisite: MAT 200
3 credits

MAT 342 Applied Complex Analysis
Functions of a complex variable, calculus of residues including evaluation of real integrals, power and Laurent series, conformal mappings and applications, Laplace and Cauchy-Riemann equations, the Dirichlet and Neumann problems, and the Laplace and Hilbert transforms and their applications to ordinary and partial differential equations.
Prerequisites: C or higher in the following: MAT 203 or 205 or AMS 261; MAT 303 or 305 or AMS 361
Advisory Prerequisite: MAT 200
3 credits

MAT 351 Differential Equations: Dynamics and Chaos
A study of the long-term behavior of solutions to ordinary differential equations or of iterated mappings, emphasizing the distinction between stability on the one hand and sensitive dependence and chaotic behavior on the other. The course describes examples of chaotic behavior and of fractal attractors, and develops some mathematical tools for understanding them.
Prerequisites: C or higher in the following: MAT 203 or 205 or AMS 261; MAT 303 or 305 or AMS 361; MAT 200 or permission of instructor
3 credits

MAT 360 Geometric Structures
Formal geometries and models. Topics selected from projective, affine, Euclidean, and non-Euclidean geometries.
Pre- or Corequisites: C or higher in the following: MAT 203 or 205 or AMS 261; MAT 211 or AMS 210; MAT 200 or permission of instructor
3 credits

MAT 362 Differential Geometry of Surfaces
The local and global geometry of surfaces: geodesics, parallel transport, curvature, isometries, the Gauss map, the Gauss-Bonnet theorem.
Prerequisite: C or higher in MAT 319 or 320 or 364
3 credits

MAT 364 Topology and Geometry
A broadly based introduction to topology and geometry, the mathematical theories of shape, form, and rigid structure. Topics include intuitive knot theory, lattices and tilings, non-Euclidean geometry, smooth curves and surfaces in Euclidean 3-space, open sets and continuity, combinatorial and algebraic invariants of spaces, higher dimensional spaces.
Prerequisites: MAT 203 or 205 or AMS 261
Advisory Prerequisite: MAT 319 or 320
3 credits
MAT 371 Logic
A survey of the logical foundations of mathematics: development of propositional calculus and quantification theory, the notions of a proof and of a model, the completeness theorem, Godel’s incompleteness theorem. This course is offered as both CSE 371 and MAT 371.
Prerequisite: MAT 200 or CSE 213
3 credits

MAT 373 Analysis of Algorithms
Mathematical analysis of a variety of computer algorithms including searching, sorting, matrix multiplication, fast Fourier transform, and graph algorithms. Time and space complexity. Upper-bound, lower-bound, and average-case analysis. Introduction to NP completeness. Some machine computation is required for the implementation and comparison of algorithms. This course is offered as both CSE 373 and MAT 373.
Prerequisites: MAT 211 or AMS 210; CSE 214
3 credits

MAT 401 Seminar in Mathematics
Discussions of a specific area of interest in mathematics. The work of each semester covers a different area of mathematics. May be repeated as topic changes. Prerequisites will be announced with the topic each time the course is offered.
Prerequisites: U3 or U4 standing; additional prerequisites announced with topic
3 credits

MAT 402 Seminar in Mathematics
Discussions of a specific area of interest in mathematics. The work of each semester covers a different area of mathematics. May be repeated as topic changes. Prerequisites will be announced with the topic each time the course is offered.
Prerequisites: U3 or U4 standing; additional prerequisites announced with topic
3 credits

MAT 475 Undergraduate Teaching Practicum
Each student assists in teaching a lower-division mathematics course or works in the Mathematics Learning Center. The student’s work is regularly supervised by a faculty member. In addition, a weekly seminar is conducted. Responsibilities may include preparation of materials for student use and discussions, helping students with problems, and involvement in “alternative” teaching projects. Intended for upper-division students who have excelled in the calculus sequence. May not be used for major credit.
Prerequisite: Permission of the director of undergraduate studies
3 credits, S/U grading

MAT 487 Independent Study in Special Topics
A reading course for juniors and seniors. The topics may be chosen by the student with the approval of a supervising member of the faculty, who also takes responsibility for evaluation. A topic that is covered in a course regularly offered by the department is not appropriate for independent study. May be repeated.
Prerequisite: Permission of the director of undergraduate studies
0-6 credits

MAT 495 Honors Thesis
The student and a supervising faculty member together choose a topic in mathematics, and the student writes a substantial paper expounding the topic in a new way.
Prerequisite: Permission of the director of undergraduate studies
3 credits