MATH 101 Calculus I (4-0-4)
(Old 101)

Limits and continuity of functions of a single variable. Differentiability. Techniques of differentiation. Implicit differentiation. Local extrema, first and second derivative tests for local extrema. Concavity and inflection points. Curve sketching. Applied extrema problems. The Mean Value Theorem and applications.

Prerequisite: One Year preparatory mathematics or its equivalent

MATH 102 Calculus II (4-0-4)
(Old 102)

Definite and indefinite integrals of functions of a single variable. Fundamental Theorem of Calculus. Techniques of integration. Hyperbolic functions. Applications of the definite integral to area, volume, arc length and surface of revolution. Improper integrals. Sequences and series: convergence tests, integral, comparison, ratio and root tests. Alternating series. Absolute and conditional convergence. Power series. Taylor and Maclaurin series.

Prerequisite: MATH 101

MATH 105 Finite Mathematics (3-0-3)
(Old 131)

Linear equations and inequalities. Systems of linear equations. Basic material on matrices. Elementary introduction to linear programming. Counting techniques. Permutations and combinations. Probability for finite sample space. Basic concepts in statistics. Topics in the mathematics of finance.

Prerequisite: One year preparatory mathematics or its equivalent

MATH 106 Applied Calculus (3-0-3)
(Old 132)

The derivative. Rules for differentiation. Derivative of logarithmic, exponential, and trigonometric functions. Differentials. Growth and decay models. Definite and indefinite integrals. Techniques of integration. Integrals involving logarithmic, exponential and trigonometric functions. Integration by tables. Area under a curve and between curves. Functions of several variables. Partial derivatives and their applications to optimization.

Prerequisite: One year preparatory mathematics or its equivalent

MATH 201 Calculus III (3-0-3)
Old 201

Polar coordinates, polar curves, area in polar coordinates. Vectors, lines, planes and surfaces. Cylindrical and spherical coordinates. Functions of two and three variables, limits and continuity. Partial derivatives, directional derivatives. Extrema of functions of two variables. Double integrals, double integrals in polar coordinates. Triple integrals, triple integrals in cylindrical and spherical coordinates.

Prerequisite: MATH 102

MATH 202 Elements of Differential Equations (3-0-3)
First order and first-degree equations. The homogeneous differential equations with constant coefficients. The methods of undetermined coefficients, reduction of order, and variation of parameters. The Cauchy-Euler equation. Series solutions. Systems of linear differential equations. Applications.

MATH 208 Introduction to Differential Equations & Linear Algebra (3-0-3)
(Old 260)
Systems of linear equations. Rank of matrices. Eigenvalues and eigenvectors. Vector spaces, subspaces, bases, dimensions. Invertible matrices. Similar matrices. Diagonalizable matrices. Block diagonal and Jordan forms. First order differential equations: separable and exact. The homogeneous differential equations with constant coefficients. Wronskian. Non-homogeneous differential equations. Methods of undetermined coefficients and variation of parameters. Systems of differential equations. Non-homogeneous systems.
Note: Not to be taken for credit with MATH 202 or MATH 225

MATH 302 Engineering Mathematics (3-0-3)
Vector analysis including vector fields, gradient, divergence, curl, line and surface integrals, Gauss' and Stokes' theorems. Introduction to complex variables. Vector spaces and subspaces. Linear independence, basis and dimension. Solution of linear equations. Orthogonality. Eigenvalues and eigenvectors. Applications to systems of differential equations.
***Note*:** Not to be taken for credit with MATH 225 or MATH 333
Prerequisite: MATH 201

MATH 333 Methods of Applied Mathematics I (3-0-3)
(Old 301)
Special functions. Bessel's functions and Legendre polynomials. Vector analysis including vector fields, divergence, curl, line and surface integrals, Green's, Gauss' and Stokes' theorems. Sturm-Liouville theory. Laplace transforms. Fourier series and transforms. Introduction to partial differential equations and boundary value problems in rectangular, cylindrical and spherical coordinates.
Prerequisite: MATH 201 and (MATH 202 or MATH 208)

MATH 210 (Old Code 232) Introduction to Sets and Structures (3-0-3)
Elementary logic. Methods of proof. Set theory. Mathematical induction. Relations and functions. Equivalence relations and congruence. Partially ordered sets. Well-ordering and axiom of choice. Cardinality of sets. Divisibility and the fundamental theorem of arithmetic, Groups, subgroups, symmetric groups, cyclic groups and order of an element, isomorphisms, cosets and Lagrange's Theorem.
Prerequisite: MATH 102 (Not to be taken for credit with ICS 253)

MATH 225 Introduction to Linear Algebra (3-0-3)
(Old 280)
The Matrices and systems of linear equations. Vector spaces and subspaces. Linear independence. Basis and dimension. Inner product spaces. The Gram-Schmidt process. Linear transformations. Determinants. Diagonalization. Real quadratic forms.
Prerequisite: MATH 102 [In Undergraduate Bulletin (2015), Corequisite: MATH 201]

MATH 310 (New Course) Logic and Set Theory (3-0-3)

The Propositional Logic, First-order predicate calculus. Truth and Models. Soundness and Completeness for Propositional Logic. Deduction. Models of Theories. Interpretations. Soundness and Completeness Theorems for first-order logic. The Compactness Theorem. Nonstandard models. Naive Set Theory. Zermelo-Fraenkel Axioms. Wellorders and Ordinal Numbers. ON as a proper class. Arithmetic of Ordinals. Transfinite Induction and Recursion. Cardinality. Goodstein Sequences.

The course syllabus matches with the course description: The course has never been offered. No syllabus is available.

MATH 315 Development of Mathematics (3-0-3)
(Old 305)

History of numeration: Egyptian, Babylonian, Hindu and Arabic contributions. Start of Arabic Arithmetic: numbers, arithmetic operations and fractions. Algebra: arithmetic algebra and algebraic geometry including the contributions of Al-Khwarizmi and his followers and detail works of Umar alkhaiam. And some applications to algebra. Number theory: prime numbers, admirable numbers and perfect numbers, combinatorics of integers and codes. Geometry: development through different eras with more emphasis on Greeks' contributions. Areas: approximation of π, the work of Al-Toussi on Euclid's axioms. Trigonometric: development through eras (Hindu, Greek, Arab and European) with some applications. Analysis: the calculus: works of Altossi, and Newton. An introduction to some famous old open problems.

MATH 323 Modern Algebra I (3-0-3)
(Old 345)

Review of basic group theory including Lagrange's theorem. Normal subgroups, factor groups, homomorphisms, fundamental theorem of finite Abelian groups. Examples and basic properties, integral domains and fields, ideal and factor rings, homomorphisms. Polynomials, factorization of polynomials over a field, factor rings of polynomials over a field. Irreducible elements and unique factorization, principal ideal domains.

Prerequisite: MATH 210 or (ICS 253 and ICS 254)

MATH 325 Linear Algebra (3-0-3)
(Old 355)

Theory of vector spaces and linear transformations. Direct sums. Inner product spaces. The dual space. Bilinear forms. Polynomials and matrices. Triangulation of matrices and linear transformations. Hamilton-Cayley theorem.

Prerequisite: MATH 280

MATH 341 Advanced Calculus I (3-0-3)
(Old 311)

The real number system. Continuity and limits. Uniform continuity. Differentiability of functions of one variable. Definition, existence and properties of the Riemann integral. The fundamental theorem of calculus.

The course syllabus matches with the course description:

MATH 353
(Old 330) Euclidean and Non-Euclidean Geometry (3-0-3)
Classical Euclidean and non-Euclidean geometries. Matrix representations of transformations in R3. Isometries. Transformation and symmetric groups. Similarity and affine transformations.
The course syllabus matches with the course description:

MATH 371 Introduction to Numerical Computing (3-0-3)
(Old 321)
Floating-point arithmetic and error analysis. Solution of non-linear equations. Polynomial interpolation. Numerical integration and differentiation. Data fitting. Solution of linear algebraic systems. Initial and boundary value problems of ordinary differential equations.
Note: Not to be taken for credit with CISE 301
***Prerequisite*:** MATH 201, ICS 101 or ICS 102 or ICS 103

Summer Training (0-0-2)
MATH 399
Old 399
Students are required to spend one summer working in industry prior to the term in which they expect to graduate. Students are required to submit a report and make a presentation on their summer training experience and the knowledge gained.

MATH 423 Modern Algebra II (3-0-3)
(Old 450)
Finite and finitely generated Abelian groups. Solvable groups. Nilpotent groups. Sylow theorems. Factorization in integral domains. Principal ideal domains. Fields. Field extensions. Finite fields. An introduction to Galois theory.
Prerequisite: MATH 323

MATH 424 Applied Algebra (3-0-3)
(Old 452)
Boolean algebras. Symmetry groups in three dimensions. Polya-Burnside method of enumeration. Monoids and machines. Introduction to automata theory. Error correcting codes.
The course syllabus matches with the course description:

MATH 427 Number Theory (3-0-3)
(Old 455)
Divisibility and primes. Congruences. Primitive roots. Quadratic reciprocity. Arithmetic functions. Diophantine equations. Applications (e.g. cryptography or rational approximations).
The course syllabus matches with the course description:

MATH 431 Applied matrix theory (3-0-3)
(Old 460)
Review of the theory of linear systems. Eigenvalues and eigenvectors. The Jordan canonical form. Bilinear and quadratic forms. Matrix analysis of differential equations. Variational principles and perturbation theory: the Courant minimax theorem, Weyl's inequalities, Gershgorin's theorem, perturbations of the spectrum, vector norms and related matrix norms, the condition number of a matrix.
Prerequisite: MATH202, MATH 225

MATH 433 Methods of Applied Mathematics II (3-0-3)
(Old 401)
Introduction to linear spaces and Hilbert spaces. Strong and weak convergence. Orthogonal and orthonormal systems. Integral Equations: Fredholm and Volterra equations. Green's Function: Idea of distributions, properties of Green's function and construction. Any one of the following topics: Asymptotic Methods: Laplace method, Steepest descent method, Perturbation Theory: regular and singular perturbations, Integral Transforms: Fourier, Laplace, Mellin and Hankel transforms.
Prerequisite: MATH 333

MATH 434 Calculus of Variations and Optimal Control (3-0-3)
(Old 442)
Introduction to the calculus of variations. Euler-Lagrange, Weierstrass, Legendre and Jacobi necessary conditions. Formulation of optimal control problems. Bolza, Mayer and Lagrange formulations. Variational approach to optimal control. Pontryagin maximum principle.
Prerequisite: MATH 202

MATH 435 Ordinary Differential Equations (3-0-3)
(Old 465)
First order scalar differential equations. Initial value problems. Existence, uniqueness, continuous dependence on initial data. Linear systems with constant coefficients. The exponential matrix. Asymptotic behavior of linear and almost linear systems. Two dimensional autonomous systems. Critical points and their classifications. Phase plane analysis. Introduction to the theory of Lyapunov stability.
Prerequisite: MATH 202 and MATH 225, or MATH 208

MATH 437 Partial Differential Equations (3-0-3)
(Old 470)
First order quasilinear equations. Lagrange method and Characteristics. Classification of linear second order PDEs, Brief review of separation of variables. The one dimensional wave equation: its solution and characteristics. Cauchy problem for the wave equation. Laplace's equation: The maximum principle, uniqueness theorems. Green's function. Neumann's function. The heat equation in one dimension.
Prerequisite: MATH 301

MATH441 (Old411) Advanced Calculus II (3-0-3)
Theory of sequences and series of functions. Real functions of several real variables: limit, continuity, differentiability. Taylor's theorem. Maxima and minima, Lagrange multipliers rule. Elementary notion of integration on RN. Change of variables in multiple integrals, Fubini's theorem. Implicit and inverse function theorems. Convergence and divergence of improper integrals- Differentiation under the integral sign.
The course syllabus matches with the course description:

MATH 443 Advanced Calculus III (3-0-3)
(Old Code 412)
Functions of bounded variation. The Riemann-Stieltjes integral. Implicit and inverse function theorems. Lagrange multipliers. Change of variables in multiple integrals. Vector functions and fields on Rn. Line and surface integrals. Green's theorem. Divergence theorem. Stokes' theorem.
The course syllabus matches with the course description:

MATH 445 Introduction to Complex Variables (3-0-3)
(Old 430)
The theory of complex analytic functions, Cauchy's integral theorem, contour integrals, Laurent expansions, the residue theorem with applications, evaluation of improper real integrals and series, conformal mappings.
Prerequisite: MATH 201

MATH 451 DIFFERENTIAL GEOMETRY (3-0-3)
(Old 440)
Curves in 3-dimensional Euclidean space: the Frenet frame and formulae, curvature and torsion, natural equations. Surfaces in 3-dimensional Euclidean space: tangent plane, first fundamental form and isometries, second fundamental forms, normal and principal curvatures, Gaussian and mean curvatures, geodesics. Geometry of the sphere and the disc (with Poincare metric)
Prerequisite: MATH 201

MATH 453
(Old 421) Introduction to Topology (3-0-3)
Topological Spaces: Basis for a topology, The order topology. The subspace topology. Closed sets and limit points. Continuous functions. The product topology, The metric topology. Connected spaces. Compact spaces. Limit point compactness. The countability axioms. The separation axioms. Complete metric spaces.
Prerequisite: MATH 201

MATH 463 Combinatorics (3-0-3)
(New Course)
Enumerative techniques, Recurrence relations, Generating functions, Principle of inclusion-exclusion, Introduction to graph theory, selected topics (e.g. Ramsey Theory, Optimization in graphs and networks, Combinatorial designs, Probabilistic methods.)
Prerequisite: MATH 201

MATH 467 Graph Theory (3-0-3)
Old (425)
Graphs and digraphs. Degree sequences, paths, cycles, cut-vertices, and blocks. Eulerian graphs and digraphs. Trees, incidence matrix, cut-matrix, circuit matrix and adjacency matrix. Orthogonality relation. Decomposition, Euler formula, planar and nonplanar graphs. Menger's theorem. Hamiltonian graphs.
The course syllabus matches with the course description:

MATH 471 Numerical Analysis I (3-0-3)
Floating-point, round-off analysis. Solution of linear algebraic systems: Gaussian elimination and LU decomposition, condition of a linear system, error analysis of Gaussian elimination, iterative improvement. Least squares and singular value decomposition. Matrix eigenvalue problems.
Prerequisite: MATH 371 or CISE 301

MATH 472 Numerical Analysis II (3-0-3)

Approximation of functions: Polynomial interpolation, spline interpolation, least squares theory, adaptive approximation. Differentiation. Integration: basic and composite rules, Gaussian quadrature, Romberg integration, adaptive quadrature. Solution of ODEs: Euler, Taylor series and Runge-Kutta methods for IVPs, multistep methods for IVPs, systems of higher-order ODEs. Shooting, finite difference and collocation methods for BVPs. Stiff equations.

Prerequisite: MATH 371 or CISE 301

MATH 475 Wavelets and Applications (3-0-3)
(Old 485)

Wavelets. Wavelet transforms. Multiresolution analysis. Discrete wavelet transform. Fast wavelet transform. Wavelet decomposition and reconstruction. Applications such as boundary value problems, data compression, etc.

Prerequisite: MATH 208 or MATH 225 or EE 207 or CISE 315

MATH 490 Seminar in Mathematics (1-0-1)

This course provides a forum for the exchange of mathematical ideas between faculty and students under the guidance of the course instructor. Students are expected to do research on a mathematical problem of their choice or the instructor's. The instructor arranges weekly presentations by himself, other faculty members and/or students, of lectures or discussions on topics or problems of general interest. The course culminates in the presentation by each student of at least one written report on a selected topic or problem, reflecting some independent work and evidence of familiarity with the mathematical literature. With the permission of the instructor, students may work with other faculty members in the preparation of written reports.

Prerequisite: Any two of MATH 323, MATH 333, MATH 341, MATH 371