**MATHEMATICS (3450)**

**3450:135 Mathematics for Everyday Life (3 Credits)**
Prerequisite: 2010:52, 2010:57, or 2010:84 with a grade of C- or better or placement test. Contemporary applications of mathematics for the non-science major to develop skills in logical thinking and reading technical material. Topics include voting, apportionment, scheduling, patterns, networks.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:140 Fundamentals of Mathematics for Primary Educators (3 Credits)**
Prerequisite: placement test or 3470:250 with a grade of C- or better. Corequisite: 5100:200. A problem-solving and inquiry-based approach to number systems; bases; operations, properties, relationships, algorithms of Real Numbers; patterns and algebra.

**3450:145 Algebra for Calculus (4 Credits)**
Prerequisite: 2010:85 with a grade of C or better or placement test. Real numbers, equations and inequalities, linear and quadratic functions. Exponential and logarithmic functions. Systems of equations, matrices, determinants. Permutations and combinations.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:149 Precalculus Mathematics (4 Credits)**
Prerequisite: 3450:145 with a grade of C- or better or placement. Functions, polynomial functions, complex numbers, exponential and logarithmic functions, systems of equations, trigonometric functions, mathematical induction, sequences, and binomial theorem.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:208 Introduction to Discrete Mathematics (4 Credits)**
Prerequisite: Completion of 3450:145 or 3450:149 with a grade of C- or better or placement. A foundation course in discrete mathematics with applications. Topics include sets, number systems, Boolean Algebra, logic, relations, functions, recursion, matrices, induction, graphs, and trees.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:209 Discrete Mathematics for Educators (4 Credits)**
Prerequisite: Completion of 3450:140 with a grade of C- or better or placement. Corequisite: 3450:231. Introduction to discrete mathematics topics for middle school instruction: sets, counting, probability, recurrence relations, graph theory, logic and elementary proof techniques.

**3450:210 Calculus with Business Applications (3 Credits)**
Prerequisite: Mathematics Placement Test or completion of 3450:145 with a grade of C- or better. Review of functions, derivatives of functions, extrema and concavity, optimization, logarithmic and exponential functions, extrema for multivariate functions. Graphing calculator required. For business or economics majors only.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:215 Concepts of Calculus (4 Credits)**
Prerequisite: Completion of 145 or 149 with a grade of C- or better or placement. Functions; limits and continuity; differentiation and applications of differentiation; logarithmic and exponential functions; integration and applications of integration; partial differentiation.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:221 Analytic Geometry-Calculus I (4 Credits)**
Prerequisite: 3450:149 with a grade of C- or better or placement test. Limits; continuity; rates of change; derivatives and applications algebraic, trigonometric, transcendental functions; curve sketching, antiderivatives and integration, areas.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:222 Analytic Geometry-Calculus II (4 Credits)**
Prerequisite: Completion of 3450:221 with a grade of C- or better. Methods and applications of integration; sequences, series and power series; Taylor polynomials and Taylor series; parametric and polar coordinates.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:223 Analytic Geometry-Calculus III (4 Credits)**
Prerequisite: Completion of 3450:222 with a grade of C- or better. Vector algebra, cylindrical, spherical coordinates, vector-valued functions, curvature; functions of several variables, limit, continuity, partial derivatives, differentials, directional derivatives, maxima and minima, multiple integrals, Divergence Theorem.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:231 Modeling with Algebraic and Transcendental Functions (4 Credits)**
Prerequisite: Completion of 3450:140 with a grade of C- or better or placement test or permission. Modeling and regression with algebraic, exponential, logarithmic, and trigonometric functions; systems of equations and matrices. These topics will be enhanced by the use of CAS.

**3450:240 Mathematical Foundations for Early Childhood Educators (3 Credits)**
Prerequisite: Completion of 3450:140 with a grade of C- or better. A problem-solving and inquiry-based approach to functions and algebra, coordinate and Euclidean geometry, and elementary data analysis.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:289 Selected Topics in Mathematics (1-3 Credits)**
Prerequisite: Permission. Selected topics of interest in mathematics.

**3450:307 Fundamentals of Advanced Mathematics (3 Credits)**
Prerequisite: Completion of 3450:209 with a grade of C- or better. Basic techniques for solving ODEs and systems of ODEs. Analysis of models involving differential equations of first order and simple equations of second order.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:312 Linear Algebra (3 Credits)**
Prerequisite: Completion of 3450:223 with a grade of C- or better. Study of vector spaces, linear transformations, matrices, determinants, inner products, the eigenvalue problem, quadratic forms and canonical forms.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:331 Modeling with Calculus (4 Credits)**
Prerequisite: Completion of 3450:231 with a grade of C- or better. Introduction to limits, continuity, differentiation with applications, integration with applications, sequences and series. These topics will be enhanced by the use of CAS.

**3450:335 Introduction to Ordinary Differential Equations (3 Credits)**
Prerequisite: Completion of 3450:223 with a grade of C- or better or permission of instructor. Basic techniques for solving ODEs and systems of ODEs. Analysis of models involving differential equations of first order and simple equations of second order.

*Gen Ed:* Tier 1 - Quantitative Reasoning

**3450:341 Geometry and Measurement (3 Credits)**
Prerequisites: Completion of 3450:209 with a grade of C- or better, or 3450:307 with a grade of C- or better and be admitted to the College of Education. Basic Constructions, Polygons, Similarity, Pythagorean Theorem, Circles, Congruence, Perimeters and Areas of Plane Figures, Surface and Volume of Solids, Rigid Motions and Symmetry, Coordinate geometry.

**3450:401 History of Mathematics (3 Credits)**
Prerequisite: Completion of 3450:307 with a grade of "C-" or better. Origin and development of mathematical ideas.
3450:410 Advanced Linear Algebra (3 Credits)
Prerequisite: Completion of 3450:312 with a grade of C- or better. Study of vector spaces, linear transformation, canonical and quadratic forms, inner product spaces.

3450:411 Abstract Algebra I (3 Credits)
Prerequisite: Completion of 3450:307 with a grade of C- or better or permission of instructor. Study of groups, rings, fields, integral domains.

3450:412 Abstract Algebra II (3 Credits)
Prerequisite: Completion of 3450:411 with a grade of C- or better or permission of instructor. Study of groups, rings, fields, integral domains, vector spaces, field extensions, Galois theory.

3450:413 Theory of Numbers (3 Credits)
Prerequisite: Completion of 3450:222 with a grade of C- or better or permission. Euclidean algorithm, unique factorization theorem, congruences, primitive roots, indices, quadratic residues, number-theoretic functions, Gaussian integers and continued fractions.

3450:415 Combinatorics & Graph Theory (3 Credits)
Prerequisite: Completion of 3450:222 with a grade of C- or better or permission. Introduction to basic ideas and techniques of mathematical counting; properties of structure of systems.

3450:420 Mathematical Technology and Communication (3 Credits)
Prerequisites: Completion of 3450:222 and 3450:312 with grades of C- or better, or permission. Graphical, numerical, and algebraic computation with applications using a variety of mathematical hardware and software: symbolic manipulators, dynamic geometry software, programs, scripts and web-browsers.

3450:421 Advanced Calculus I (3 Credits)
Sequential. Prerequisite: Completion of 3450:223 with a grade of C- or better; 3450:307 is highly recommended. Real number system, sequences, series, set theory, continuity, differentiation, integration, partial derivatives, multiple integration, maxima and minima, convergence and uniform convergence, power series, improper integrals, transformations, line and surface integrals.

3450:422 Advanced Calculus II (3 Credits)
Sequential. Prerequisite: Completion of 3450:421 with a grade of C- or better or permission of instructor. Real number system, sequences, series, set theory, continuity, differentiation, integration, partial derivatives, multiple integration, maxima and minima, convergence and uniform convergence, power series, improper integrals, transformations, line and surface integrals.

3450:425 Complex Variables (3 Credits)
Prerequisite: Completion of 3450:223 with a grade of C- or better. Complex variables; elementary functions, differentiation and analytic functions; integration and Cauchy's theorem; power series and Laurent series; residue theorem; applications such as conformal mappings, inversion of integral transform.

3450:427 Applied Numerical Methods I (3 Credits)
Prerequisites: Completion of 3450:222 and 3460:209 with grades of C- or better or permission. Numerical methods in polynomial interpolation, rootfinding, numerical integration, and numerical linear algebra.

3450:428 Applied Numerical Methods II (3 Credits)
Prerequisites: Completion of 3450:335 and 3450:427 with grades of C- or better or permission. Numerical methods in the solution of ordinary and partial differential equations. Numerical differentiation, Runge-Kutta methods, and iterative methods for ODEs, finite differences for PDEs.

3450:430 Numerical Solutions for Partial Differential Equations (3 Credits)
Prerequisite: Completion of 3450:428 with a grade of C- or better or equivalent. For advanced undergraduate and graduate students. The study of finite difference and finite element methods for partial differential equations consistency, stability, convergence and computer implementation.

3450:432 Partial Differential Equations (3 Credits)
Prerequisite: Completion of 3450:335 with a grade of C- or better. The classical initial value and boundary value problems of mathematical physics developed and solved using Fourier series and integral transforms.

3450:435 Systems of Ordinary Differential Equations (3 Credits)
Prerequisites: Completion of 3450:335 and either 3450:312 or 3450:428 with grades of C- or better or permission. Analysis, solution of systems of equations, linear, nonlinear. Topics: stability theory, perturbation methods, asymptotic methods, applications from physical, social sciences.

3450:436 Mathematical Models (3 Credits)
Prerequisite: Completion of 3450:335 with a grade of C- or better, and a six-hour sequence in an approved applied area, or permission. Formulation and analysis of mathematical models in social and physical sciences. Analysis of deterministic and stochastic models. Topics may include stochastic processes, linear programming, graph theory, theory of measurement.

3450:438 Advanced Engineering Mathematics I (3 Credits)
Prerequisites: Completion of 3450:335 and 3450:312 with grades of C- or better or permission. Matrices, eigenvalue problems, systems of ODEs, vector analysis, complex variables.

3450:439 Advanced Engineering Mathematics II (3 Credits)
Prerequisites: Completion of 3450:335 and 3450:312 with grades of C- or better or permission. Special functions, Fourier series and transforms, PDEs.

3450:441 Concepts in Geometry (4 Credits)
Prerequisite: 3450:307 with a grade of C- or better or permission of instructor. Selected topics in mathematics and applied mathematics at an advanced level.

3450:445 Introduction to Topology (3 Credits)
Prerequisite: Completion of 3450:307 with a grade of C- or better or permission of instructor. Introduction to topological spaces and topologies, mappings, cardinality, homeomorphisms, connected spaces, metric spaces.

3450:489 Topics in Mathematics (1-4 Credits)
(May be repeated for a total of 12 credits) Prerequisite: Permission of instructor. Selected topics in mathematics and applied mathematics at an advanced level.

3450:491 Workshop in Mathematics (1-4 Credits)
(May be repeated) Group studies of special topics in mathematics and applied mathematics. May not be used to meet undergraduate or graduate major requirements. May be used for elective credit.

3450:497 Individual Reading: Mathematics (1-2 Credits)
Prerequisites: senior standing and permission. Mathematics or applied mathematics majors only. Directed studies designed as an introduction to research problems, under guidance of selected faculty member.
3450:498 Senior Honors Project: Mathematics (1-3 Credits)
Prerequisite: Permission of Instructor. Directed study for senior student in the Honors Program. An introduction to research problems in mathematics and applied mathematics under the guidance of selected faculty. May be repeated for up to six credits.