

MATHEMATICS (MATH)

MATH 051 - Basic Skills MATH II: Algebra 3 Credits

Prerequisite(s): Juniors and seniors should contact the Center for Academic Development and Assessment. Basic elementary algebra course, includes fundamental algebraic processes, linear and quadratic equations, graphing and applications. Credits not usable toward graduation. Meets Basic Skills Requirement. This course is offered as Pass/No Credit only. 3 hours lecture.

MATH 061 - Basic Skills Mathematics Laboratory: Algebra 3 Credits

Prerequisite(s): Juniors and seniors should contact the Center for Academic Development and Assessment. Special fee. Review of elementary algebra, including fundamental algebraic processes, linear and quadratic equations, graphing, word problems and applications. Credit not usable toward graduation. Computer assisted including lecture, individual and small group tutoring in Mathematics Computer Laboratory. This course is offered as Pass/No Credit only. Meets Basic Skills Requirement. 3 hours lab.

MATH 071 - Basic Skills Mathematics-Precollege Algebra 3 Credits

Prerequisite(s): Score of 71 or less on the Accuplacer Placement Test. Review of elementary algebra, including fundamental algebraic processes, linear and quadratic equations, graphing, word problems, and applications. This course is offered as Pass/NC only. Computer centered model includes online lectures, textbook and homework, lab sessions with on-demand tutoring support, and small group active learning sessions in the Mathematics Computer Laboratory. Credit not usable for graduation. 1 hour lecture, 2.5 hours lab.

MATH 100 - Intermediate Algebra 3 Credits

Special fee. Topics include sets, relations, functions, development of number systems and algebraic operations. Students who received high school credit for Intermediate Algebra may not receive degree credit for MATH 100. Computer centered model includes online lectures, textbook and homework, lab sessions with on-demand tutoring support, small group active learning sessions as well as optional individual tutoring in the Mathematics Computer Laboratory. This class does not count for credit toward the degree for the following majors: Math, Computer Science, Information Technology, Science Informatics. 3 hours lecture.

MATH 101 - Math Workshop 1 Credit

This course is offered to strengthen the students' mathematical foundation. It is a prerequisite or corequisite for MATH 103, MATH 106 and MATH 109 for students that have not successfully completed the basic skills math requirement. It is also open to students that have completed the requirement (but need extra practice) that are taking or planning to enroll in MATH 103, MATH 106 or MATH 109. The course will provide just-in-time remediation to students and the curriculum will be aligned with that of MATH 103, MATH 106 and MATH 109. Students may not withdraw from this course without advisor approval. Withdrawal from this course requires withdrawal from MATH 103, MATH 106 or MATH 109 as well. May be repeated for a maximum of 2 credits.

MATH 102 - New Student Experience for Mathematical Sciences 1 Credit

This course introduces students to the University, the Department of Mathematical Sciences and the culture of higher education. Students learn about campus resources and activities, the disciplines of mathematics and physics, careers in mathematical sciences, and development of good study skills. There is also emphasis on issues related to health, wellness, diversity, and prejudice. Meets Gen Ed - New Student Seminar. 1 hour lecture.

MATH 103 - The Development of Mathematics 3 Credits

A survey of traditional and contemporary mathematical topics developed within a historical framework and designed to develop an appreciation for the role and universality of mathematics as a cultural force in our society. Computer centered model includes online lectures, textbook and homework, lab sessions with on-demand tutoring support, small group active learning sessions as well as optional individual tutoring in the Mathematics Computer Laboratory. Meets Gen Ed - Mathematics. Not for majors in the College of Science and Mathematics. 3 hours lecture.

MATH 104 - Fractals and Infinity 3 Credits

A study of the beauty of fractals, their numerical and geometric structure, and their fascinating connection to infinity and other branches of mathematics and related fields such as science, art, philosophy, and religion. Many hands-on, visualization, and computer activities and experiences offer rich opportunities to explore, create, and illustrate the dynamics of fractals and mathematics in general by stretching the mind beyond the finite to the infinite, offering a new view of the world we live in. Cross listed with the Honors Program, HONP 104. Meets Gen Ed 2002 - Mathematics. 3 hours lecture.

MATH 106 - Contemporary Applied Math for Everyone 3 Credits

The impact of modern mathematics on today's society in terms of management decision making, scheduling and planning, social choice, including voting and apportionment, population studies, and measurements of size and shape. Meets Gen Ed - Mathematics. 3 hours lecture.

MATH 109 - Statistics 3 Credits

Introduction to the use of statistics in the real world. Topics include: analysis and presentation of data, variability and uncertainty in data, techniques of statistical inference and decision-making. Computer centered model includes online lectures, textbook and homework, lab sessions with on-demand tutoring support, small group active learning sessions as well as optional individual tutoring in the Mathematics Computer Laboratory. Meets Gen Ed - Mathematics. Not for majors in Mathematics, Mathematics with Applied Math concentration, Mathematics-Teacher Education or Biology. 3 hours lecture.

MATH 110 - Statistics for the Biological Sciences 4 Credits

Prerequisite(s): MATH 100 or placement through the Montclair State University Placement Test. Introduction to the use of statistics in the real world with an emphasis on biological data. Topics include: analysis and presentation of data, variability and uncertainty in data, techniques of statistical inference and decision-making. This course is intended for Biology majors. Statistical software such as JMP will be used. Not for mathematics majors. Meets Gen Ed - Mathematics. 4 hours lecture.

MATH 111 - Applied Precalculus 4 Credits

Prerequisite(s): MATH 100 with a grade of C- or better or placement through the Montclair State University Placement Test (MSUPT). This course covers topics, including trigonometric, exponential, logarithmic, rational, and polynomial functions, that are basic to success in the calculus sequence. Includes applications to Biology, Molecular Biology, and other empirical sciences. Uses graphics calculators extensively. May be substituted for MATH 112 (Precalculus Mathematics). 4 hours lecture.

- MATH 112 - Precalculus Mathematics** **3 Credits**
Prerequisite(s): MATH 100 or placement through the Montclair State University Placement Test (MSUPT) or a satisfactory score on department's Precalculus Readiness Test. (Students who did not satisfy the course prerequisite at MSU and students who received a grade of D-, D, or D+ in the prerequisite course taken at MSU are required to demonstrate competency on the department's Precalculus Readiness Test.) Binomial theorem, relations and functions, exponential and logarithmic functions, right triangle trigonometry, circular functions. 3 hours lecture.
- MATH 113 - Mathematics for Business I: Linear Algebra** **3 Credits**
Prerequisite(s): MATH 100 or placement through the Montclair State University Placement Test (MSUPT). Matrices, linear programming, probability, statistics. 3 hours lecture.
- MATH 114 - Mathematics for Business II: Calculus** **3 Credits**
Prerequisite(s): MATH 100 or placement through the Montclair State University Placement Test (MSUPT) or a satisfactory score on department's Business Calculus Readiness Test. (Students who did not satisfy the course prerequisite at MSU and students who received a grade of D-, D, or D+ in the prerequisite course taken at MSU are required to demonstrate competency on the department's Business Calculus Readiness Test.) The general aim of this course is to introduce the students to the basic skills of differentiation, integration, maxima-minima problems and several of the other applications of calculus, including modeling, especially models in business and economics. Computer assisted including lecture, individual and small group tutoring in Mathematics Computer Laboratory. 3 hours lecture.
- MATH 115 - Supplemental Topics in Statistics for Biology** **1 Credit**
Prerequisite(s): MATH 109 (or equivalent) and MATH 100 or placement through the Montclair State University Placement Test (MSUPT). Intended for Biology majors who have previously taken Math 109 (3 credits), or equivalent under, new requirement to take MATH 110: Statistics for Biological Sciences (4 credits). Introduction to the use of statistics in the real world with an emphasis on biological data. Topics include: analysis and presentation of data, techniques of statistical inference and decision-making with an emphasis on bivariate and multivariate data. Not for mathematics majors. May be repeated for a maximum of 2 credits. 1 hour lecture.
- MATH 116 - Calculus A** **4 Credits**
Prerequisite(s): MATH 111 or MATH 112 with a grade of C- or better or placement through the Montclair State University Placement Test (MSUPT). Differentiation and integration of functions, including trigonometric functions. Applications to biology and geoscience. Meets Gen Ed - Mathematics. 4 hours lecture.
- MATH 118 - Mathematics and Computer Science for the Life Sciences II** **3 Credits**
Prerequisite(s): MATH 117. Mathematical models; hypothesis testing; genetics models; diversity in populations; randomness; contingency tables; regression analysis; tests of biological models. Methods of course applied to real biological data throughout with micro-computers used as a tool. 3 hours lecture.
- MATH 120 - Calculus I: Problem Solving and Computing Workshop** **1 Credit**
Corequisite(s): MATH 122. This is a supplementary problem solving section for Calculus I students, utilizing computer technology. Topics will include functions, limits, derivatives, anti-derivatives, the definite integral, and others from Calculus I. Free elective credit only. This course is offered as Pass/Fail only. 2 hours lab.
- MATH 122 - Calculus I** **4 Credits**
Prerequisite(s): MATH 111 or MATH 112 with a grade of C- or better or placement through the Montclair State University Placement Test (MSUPT). Limits, continuity; derivative and differentiation; applications of the derivative, maxima, minima, and extreme considerations; antiderivatives; Riemann integral. Meets Gen Ed - Mathematics. 4 hours lecture.
- MATH 190 - Topics in Undergraduate Mathematics** **1-4 Credits**
Topics of current interest and importance that are accessible by first- and second-year students. May be repeated once for a maximum of 8.0 credits. 4 hours lecture.
- MATH 195 - Reasoning and Problem Analysis for Pre-Law and Paralegal Students** **3 Credits**
Prerequisite(s): MATH 100. Mathematical problem analysis, reasoning and proof applicable and transferable to law school study, including analysis of legal decision making. 3 hours lecture.
- MATH 220 - Calculus II: Problem Solving and Computing Workshop** **1 Credit**
Corequisite(s): MATH 221. This is a supplementary problem solving section for Calculus II students, utilizing computer technology. Topics will include applications of the definite integral, methods of integration, L'Hospital's rule, sequences, series, and others from Calculus II. Free elective credit only. This course offered as Pass/Fail only. 2 hours lab.
- MATH 221 - Calculus II** **4 Credits**
Prerequisite(s): MATH 122 with grade of C- or better. Riemann integral applications, transcendental functions, techniques of integration, improper integrals, L'Hospital's Rule, infinite series, vector algebra. 4 hours lecture.
- MATH 222 - Calculus III** **4 Credits**
Prerequisite(s): MATH 221 with a grade of C- or better. Partial differentiation, and extreme considerations; polar, cylindrical, and spherical coordinates, multiple integration; introduction to line integrals, vector calculus. 4 hours lecture.
- MATH 224 - Introduction to Differential Equations** **3 Credits**
Prerequisite(s): MATH 221 with a grade of C- or better. The course introduces students to the study of differential equations, including: first order equations, mathematical modeling, qualitative methods, numerical methods, and second order equations. The solutions of linear systems of differential equations are presented by a brief introduction to elementary algebra. Emphasis is on the applications and techniques for finding solutions. 3 hours lecture.
- MATH 235 - Introduction to Linear Algebra** **4 Credits**
Prerequisite(s): MATH 221 with a grade of C- or better. Linear algebra and its applications. Topics include matrices, determinants, vector spaces, eigenvalues and eigenvectors, orthogonality and inner product spaces. May include computer use in solving problems. 4 hours lecture.
- MATH 242 - Biostatistics** **3 Credits**
Prerequisite(s): MATH 122; not for mathematics or computer science majors. Applications of statistical methods to toxicology. Experimental design, descriptive statistics, random sampling, estimation, inference, hypothesis testing: one and two sample test; anova, quality control, regression and bio-assay. Microcomputer and statistical packages. 3 hours lecture.

MATH 270 - Statistics for Business**3 Credits**

Prerequisite(s): MATH 114. May not be taken for graduation credit by College of Science and Mathematics majors. This course is a comprehensive introduction to the application of modern statistical methods. Topics covered include descriptive statistical methods of data analysis; an introduction to probability theory; an introduction to discrete and continuous probability distributions and mathematical expectation; classical statistical inference - sampling distributions, confidence interval estimation, and hypothesis testing for means and proportions; regression and correlation; and an introduction to time series analysis. Spreadsheet software is integrated in all topics. 3 hours lecture.

MATH 320 - Transitions to Advanced Mathematics**3 Credits**

Prerequisite(s): MATH 221 with a grade of C- or better. This course will help students explore mathematics and make conjectures using technology. Students will enhance their understanding of mathematical models and to develop communication skills through the use of written reports and oral presentations of projects. The course content introduces students to difference equations, elementary linear algebra and ordinary differential equations. Further, the course will develop proof-writing skills and introduce students to the explore-conjecture-proof strategy. 3 hours lecture.

MATH 323 - Complex Variables**3 Credits**

Prerequisite(s): MATH 222 with a grade of C- or better. This course is a study of the arithmetic and algebra of complex numbers, and an introduction to the differentiation and integration of complex functions. Topics include: rectangular and polar form of complex numbers, algebra of complex numbers, differentiation, Cauchy-Riemann equations, and contour integrals. Previous course MATH 423 effective through Spring 2014. 3 hours lecture.

MATH 335 - Linear Algebra**4 Credits**

Prerequisite(s): MATH 222 with a grade of C- or better. The course content will cover the foundations of the algebra of vector spaces, matrix operations, matrix invertibility theorems, linear independence, span, basis, linear transformations, finite dimensional Hilbert Spaces, Gram-Schmidt process, projections, eigenvalues and eigenvectors, and applications. The focus of the course will be to develop advanced mathematical skills in reading and understanding abstract mathematical definitions, constructing examples, and developing mathematical proofs. Meets the University Writing Requirement for majors in Mathematics. 4 hours lecture.

MATH 340 - Probability**3 Credits**

Prerequisite(s): MATH 221 with a grade of C- or better. Chance and variability, elements of combinatorics, Bayes' theorem, random variables, binomial, poisson and normal distributions, applications to statistics. 3 hours lecture.

MATH 350 - College Geometry**3 Credits**

Prerequisite(s): MATH 320 with a grade of C- or better. The study of a wide range of advanced concepts in Euclidean geometry suitable for teaching foundations of axiomatic systems at the high school or middle school level. Topics involving triangle congruence, parallel line postulate, properties of polygons and circles, area, volume, Pythagorean Theorem, similarity, transformations and geometric constructions will be studied from an advanced, proof-based perspective. Basics of Non- Euclidian geometries will be introduced. Geometers' Sketchpad and other software will be utilized. 3 hours lecture.

MATH 360 - Mathematical Modeling in Biology**3 Credits**

Prerequisite(s): MATH 221 (or MATH 116 and BIOL 213 for Biology Majors). The course introduces students to the study of mathematical modeling in the biological and medical sciences. Continuous and discrete dynamical systems will be used to describe topics such as interacting and structured populations, biological control, population genetics and evolution, biological oscillators and switches, pattern formation, and the dynamics of infectious diseases. Each topic will be presented in its historical context, leading to questions of current research interest and providing a comprehensive overview of the field and a solid foundation for interdisciplinary research in the biological sciences. Emphasis is on applications and mathematical techniques for finding solutions. 3 hours lecture.

MATH 365 - Mathematics and Music**3 Credits**

Prerequisite(s): MATH 221 with a grade of C- or better. Mathematics of Musical Instruments, Sound Waves and Harmonics, Elements of Fourier Theory, Consonance and Dissonance, Scales and Temperaments, Symmetry in Music. 3 hours lecture.

MATH 368 - Fluid Mechanics**3 Credits**

Prerequisite(s): MATH 222 with a grade of C- or better. Mechanics of continuous media, liquids and gases; stress, viscosity, Navier-Stokes and Euler Equations, exact solutions, potential flow, circulation and vorticity, dimensional analysis and asymptotic models, boundary layers, stability theory and applications to industrial environmental problems. Cross listed with PHYS 368. Previous course MATH 468 effective through Spring 2014. 3 hours lecture.

MATH 370 - Mathematics for Teaching**3 Credits**

Prerequisite(s): MATH 350 with a grade of C- or better and admission into the Teacher Education program. This course will focus on the Common Core State Standards Mathematics (CCSSM) aligned with the content areas of number and quantity, pre-algebra and algebra, and statistics and probability. These topics will be presented with the goal of fostering pre-service mathematics teachers' (PSMT's) understanding of and commitment to teaching mathematics that promotes student understanding. PSMTs will explore mathematical content deeply while also discussing related pedagogical tools, including teaching methods, curricula, lesson planning, technology resources, and assessment practices. 3 hours lecture.

MATH 398 - Vector Calculus**3 Credits**

Prerequisite(s): MATH 335 with a grade of C- or better. Topics include the algebra of the differential and integral calculus; gradients, divergence and curl of a vector field, and integral theorems together with applications drawn from the physical sciences. 3 hours lecture.

MATH 401 - Fundamentals of Pre-Service Mathematics**1 Credit**

Prerequisite(s): MATH 350, Failing score on Praxis II Mathematics Content Knowledge Exam or those that plan to take the Praxis II Mathematics Content Knowledge Exam. This course will focus on the fundamental mathematics topics necessary for pre-service teachers to have a mastery of mathematics content knowledge in preparation for careers in teaching. Students study an overview of four major content areas in mathematics: number and quantity, algebra, functions, calculus, geometry, probability and statistics, and discrete mathematics. For mathematics majors seeking a P-12 teaching license. Maybe taken for a maximum of 3 credits. 1 hour lecture.

MATH 420 - Ordinary Differential Equations**4 Credits**

Prerequisite(s): MATH 335 with a grade of C- or better. A course in the theory and applications of ordinary differential equations which emphasizes qualitative aspects of the subject. Topics include analytic and numerical solution techniques for linear and nonlinear systems, graphical analysis, existence-uniqueness theory, bifurcation analysis, and advanced topics. 4 hours lecture.

MATH 421 - Partial Differential Equations**3 Credits**

Prerequisite(s): MATH 420 with a grade of C- or better. Partial differential equations arise in the mathematical modeling of many physical, chemical, and biological phenomena. They play a crucial role in diverse subject areas, such as fluid dynamics, electromagnetism, material science, astrophysics, financial modeling, and hydrogeology, for example. This course is an introduction to partial differential equations with emphasis on the wave, diffusion and Laplace equations. The focus will be on understanding the physical meaning and mathematical properties of solutions of partial differential equations. Methods of solutions include separation of variables using orthogonal series, transform methods, method of characteristics, and some numerical methods. 3 hours lecture.

MATH 425 - Advanced Calculus I**3 Credits**

Prerequisite(s): MATH 335 with a grade of C- or better. Properties of the real number system, limits, continuous functions, intermediate value theorem, derivative, mean value theorem, Riemann integral. 3 hours lecture.

MATH 426 - Advanced Calculus II**3 Credits**

Prerequisite(s): MATH 425 with a grade of C- or better. This course is a continuation of MATH 425. Topics include functions of several variables, partial derivatives, Green's theorem, Stoke's theorem, divergence theorem, implicit function theorem, inverse function theorem, infinite series and uniform convergence. 3 hours lecture.

MATH 431 - Foundations of Modern Algebra**3 Credits**

Prerequisite(s): MATH 335 with a grade of C- or better. Fundamental concepts of algebra including groups, rings, integral domains and fields, with important examples. 3 hours lecture.

MATH 433 - Theory of Numbers**3 Credits**

Prerequisite(s): MATH 335 with a grade of C- or better. This course presents the principal ideas of classical elementary number theory, emphasizing the historical development of these results and the important figures who worked on them. Topics studied include the following: divisibility, primes, and the Euclidean Algorithm; number-theoretic functions, linear congruencies, the Chinese Remainder Theorem, the Theorems of Fermat, Euler, and Wilson; quadratic congruencies and the Law of Quadratic Reciprocity; Diophantine equations and Fermat's Last Theorem; continued fractions; Pell's equation and the sum of two squares. 3 hours lecture.

MATH 450 - Foundations of Geometry**3 Credits**

Prerequisite(s): MATH 335 with a grade of C- or better. The course deals with the fundamental ideas common to Euclidean and Non-Euclidean geometries; projective, affine, and metric geometries. 3 hours lecture.

MATH 451 - Topology**3 Credits**

Prerequisite(s): MATH 425 with a grade of C- or better. Point set topology including topics such as, metric spaces, limit points, derived sets, closure, continuity, compact sets and connected sets. 3 hours lecture.

MATH 460 - Introduction to Applied Mathematics**3 Credits**

Prerequisite(s): MATH 420 with a grade of C- or better. This course is a survey of applied mathematical techniques, including such topics as control theory (feedback control systems, Nyquist and Popov plots, pole shifting, Laplace transforms) and classical boundary value problems (Sturm-Liouville equations with solution techniques involving Fourier series). Applications will use the theory of calculus of variations which includes the variational derivative, the general variation of a functional, variation in parametric form, and the invariance of the Euler's equations. 3 hours lecture.

MATH 461 - General Relativity**3 Credits**

Prerequisite(s): MATH 335 and; PHYS 191 or PHYS 192. An introduction to Einstein's geometric theory of gravity. Topics will include: special relativity, 4-vectors, the twin paradox, the metric tensor, non-Euclidean geometry, the equivalence principle, the gravitational redshift, geodesics, the Schwarzschild solution, and black holes. 3 hours lecture.

MATH 463 - Numerical Analysis**3 Credits**

Prerequisite(s): MATH 335 with a grade of C- or better. Finite differences, approximation theory, linear and non-linear equations, error analysis. 3 hours lecture.

MATH 464 - Operations Research I**3 Credits**

Prerequisite(s): MATH 335 with a grade of C- or better. Linear programming, transportation problem, assignment problem, duality, sensitivity analysis, network flows, dynamic programming, nonlinear programming, integer programming. 3 hours lecture.

MATH 465 - Operations Research II**3 Credits**

Prerequisite(s): MATH 335 and MATH 340 both with a grade of C- or better. Game theory, queuing models, inventory models, Markov processes, reliability theory and applications. 3 hours lecture.

MATH 466 - Mathematics of Finance I**3 Credits**

Prerequisite(s): FINC 321 and MATH 340 both with a grade of C- or better. Mathematical theory of interest rates, annuities, bond valuation, stock valuation, options, arbitrage, binomial trees, put-call parity, Black Scholes Model, Capital Asset Pricing Model (CAPM) and portfolio selection. 3 hours lecture.

MATH 467 - Mathematics of Finance II**3 Credits**

Prerequisite(s): MATH 466 with a grade of C- or better. Mathematical theory of forward/futures contract, hedging with futures, fixed income market analysis, duration, immunization, financial swaps, interest swaps, currency swaps, future options, Black Scholes Model, put-call parity, binomial trees, other options, and volatility. This course can be used as part of preparation for SOA/CASACT Actuarial Examinations, Course 2. 3 hours lecture.

MATH 469 - Mathematical Modeling**3 Credits**

Prerequisite(s): MATH 420 and MATH 340; and MATH 464 or STAT 330 all with a grade of C- or better. The art of constructing mathematical models for "real world" problems, solving the model, and testing the accuracy of the model. Problems will be selected from business, science, computer science, and the social sciences. 3 hours lecture.

MATH 470 - Teaching of Mathematics**4 Credits**

Prerequisite(s): MATH 335 with a grade of C- or better and admission into the Teacher Education Program. Selection, organization, and presentation of secondary mathematics, classroom activities, lesson planning, techniques of motivation, evaluation, multisensory aids, principles of learning, and applications of the microcomputer to classroom teaching. 4 hours lecture.

- MATH 471 - Selected Topics in Modern Mathematics** 3 Credits
Prerequisite(s): MATH 335 with a grade of C- or better and admission into the Teacher Education Program. Professionalized view of junior and senior high school mathematics topics: functions, real and complex numbers, analytic geometry, absolute value and inequalities, sets and logic, flow charting, linear programming. 3 hours lecture.
- MATH 475 - History of Mathematics** 3 Credits
Prerequisite(s): MATH 335 with a grade of C- or better. This course surveys the origins and evolution of mathematical ideas from the antiquity to the present. Emphasis will be on the role of mathematics as an integral part of our cultural heritage and its relationship to areas such as science, art, religion, philosophy and literature. Classical mathematical methods will be examined by reading selected original works by great mathematicians. 3 hours lecture.
- MATH 485 - Applied Combinatorics and Graph Theory** 3 Credits
Prerequisite(s): MATH 340 with a grade of C- or better. Problem solving by counting, enumeration, and graph theory. Permutation, combinations, binomial coefficients, generating functions, and recurrence relations, partitions, inclusion-exclusion, Polya's formula, graph theoretic models, trees, circuits, networks, matching, and their applications to puzzles, games, tournaments, traffic patterns, transportation. 3 hours lecture.
- MATH 487 - Introduction to Mathematical Cryptography** 3 Credits
Prerequisite(s): MATH 335 with a grade of C- or better. A modern introduction to the application of number theory, combinatorics and abstract algebra to cryptography. Specifically, this includes modular arithmetic, generating polynomials and matrix algebra over rings and fields. A discussion of a broad range of applications of mathematics to the security of credit cards, cell phones and codes among numerous other current examples will be covered. Current industry protocols will be explored. 3 hours lecture.
- MATH 490 - Honors Seminar** 3 Credits
Prerequisite(s): MATH 335 with a grade of C- or better; and departmental approval. This course will concentrate on subject matter not usually covered within standard mathematics courses. A written and oral report are required. 3 hours seminar.
- MATH 491 - Research in Mathematics Education** 3 Credits
Prerequisite(s): MATH 350 and departmental approval. Research in Mathematics Education Research in an area of mathematics education agreed upon by the student and the instructor. The results of the research will be the basis of a seminar, colloquium, or conference presentation to be given by the student. May be repeated for a maximum of 6 credits with either a new research topic or continued research on the current topic. 3 hours seminar.
- MATH 495 - Topics for Undergraduates** 1-3 Credits
Prerequisite(s): MATH 335 and MATH 340 both with a grade of C- or better; and departmental approval. Study of advanced topics in undergraduate mathematics. May be repeated for a maximum of 6.0 credits as long as the topic is different. 1 hour lecture.
- MATH 497 - Mathematics Research I** 1-3 Credits
Prerequisite(s): MATH 335 with a grade of C- or better; and departmental approval. Individual research in a mathematical area agreed upon by the student and the instructor. The results of the research will be a basis of a seminar or colloquium to be given by the student. Students must not accumulate more than 6 credits total in courses MATH 497, 498.
- MATH 498 - Mathematics Research II** 1-3 Credits
Prerequisite(s): MATH 335 with a grade of C- or better; and departmental approval. Individual research in a mathematical area agreed upon by the student and the instructor. The results of the research will be a basis of a seminar or colloquium to be given by the student. Students must not accumulate more than 6 credits total in courses MATH 497, 498.
- MATH 502 - Mathematics for Computer Science II** 3 Credits
Prerequisite(s): Graduate program coordinator's permission. An introduction to linear algebra, vectors, matrices, counting rules, probability theory, random variables, Poisson and binomial distribution, with applications to Computer Science. May not be used for credit by Mathematics and Computer Science majors. 3 hours lecture.
- MATH 503 - Mathematics for Computer Science III** 3 Credits
Prerequisite(s): Graduate program coordinator's permission. Differential and integral calculus, infinite series, applications to computer science. May not be used for credit by Mathematics and Computer Science majors. 3 hours lecture.
- MATH 510 - Workshop in Mathematics Education I** 1-4 Credits
Prerequisite(s): Permission of graduate program coordinator. Specific contemporary topics and current issues in school mathematics. May be repeated for a maximum of 8.0 credits as long as the topic is different.
- MATH 511 - Workshop in Mathematics Education II** 1-4 Credits
Prerequisite(s): Permission of graduate program coordinator. Specific contemporary topics and current issues in school mathematics. May be repeated for a maximum of 8.0 credits as long as the topic is different.
- MATH 512 - Technology in the Middle Grades Mathematics Curriculum** 3 Credits
Prerequisite(s): Permission of graduate program coordinator. This course is designed to provide experiences in the integration of technology into middle grades mathematics classes. The primary emphases are on the analysis and evaluation of computer software addressing the middle grades mathematics courses. Other topics include the use of spreadsheets, fraction and graphing calculators, data probes, and hand-held digital assistants as problem-solving tools to enhance the teaching/learning process. The course also includes current literature describing exemplary models and practices in the use of technology in the mathematics classroom. 3 hours lecture.
- MATH 513 - Computer Science Concepts for High School Teachers** 3 Credits
Prerequisite(s): Permission of graduate program coordinator. This course is specifically designed to help high school mathematics teachers prepare to use the microcomputer as a tool in their classrooms. Topics include an introduction to computer literacy, elements of BASIC programming, the evaluation of commercial software, the appropriate use of the software and a survey of relevant professional literature. Minimal prior knowledge of BASIC is assumed. May not be used for credit by Computer Science majors. 3 hours lecture.
- MATH 514 - Advanced Placement Computer Science Concepts** 3 Credits
Prerequisite(s): Graduate program coordinator's permission. This course is specifically designed to help senior high school teachers prepare to instruct the AP course in computer science. Topics include the problem solving process, good programming style, the syntax of the current AP language, and their applications to computer science. Additional topics include algorithms, data structures, procedures, program design, sorting and searching. Minimal prior knowledge of a high level language is assumed. May not be used for credit for Computer Science majors. 3 hours lecture.

- MATH 515 - Intermediate Analysis I** **3 Credits**
Prerequisite(s): Permission of graduate program coordinator. Properties of the real number system, limits, continuous functions, intermediate value theorem, derivative, mean value theorem, Riemann integral. 3 hours lecture.
- MATH 516 - Intermediate Analysis II** **3 Credits**
Prerequisite(s): MATH 515 or MATH 425 or equivalent, permission of graduate program coordinator. This course is a continuation of MATH 515. Topics include functions of several variables, partial derivatives, Green's theorem, Stoke's theorem, divergence theorem, implicit function theorem, inverse function theorem, infinite series, uniform convergence. 3 hours lecture.
- MATH 518 - Foundations of Abstract Algebra** **3 Credits**
Prerequisite(s): Permission of graduate program coordinator. Fundamental concepts of algebra including groups, rings, integral domains and fields, with important examples. 3 hours lecture.
- MATH 519 - Teaching Mathematics** **3 Credits**
Selection, organization, and presentation of secondary mathematics, classroom activities, lesson planning, techniques of motivation, evaluation, multi-sensory aids, principles of learning, assessment, and applications of technology to classroom teaching. 3 hours lecture.
- MATH 521 - Real Variables I** **3 Credits**
Prerequisite(s): MATH 426 and permission of graduate program coordinator. Real number system, Lebesgue measure and integration, differentiation, Fourier series, LP, metric, normed vector, Banach and Hilbert spaces. 3 hours lecture.
- MATH 522 - Real Variables II** **3 Credits**
Prerequisite(s): MATH 521, permission of graduate program coordinator. Real number system, Lebesgue measure and integration, differentiation, Fourier series, LP, metric, normed vector, Banach and Hilbert spaces. 3 hours lecture.
- MATH 525 - Complex Variables I** **3 Credits**
Prerequisite(s): MATH 426 and permission of graduate program coordinator. Integration and differentiation in the complex domain, Cauchy's theorem, Cauchy's integral formula, Laurent expansion, residues, elements of conformal mapping, series and product representations. 3 hours lecture.
- MATH 526 - Complex Variables II** **3 Credits**
Prerequisite(s): MATH 525, permission of graduate program coordinator. Integration and differentiation in the complex domain, Cauchy's theorem, Cauchy's integral formula, Laurent expansion, residues, elements of conformal mapping, series and product representations. 3 hours lecture.
- MATH 530 - Mathematical Computing** **3 Credits**
Prerequisite(s): Permission of the graduate program coordinator or consent of the instructor. Introduction to mathematical computing techniques using a computer algebra system and algorithmic approach to solving mathematical problems. Mathematical applications taken from various areas of mathematics, the sciences, engineering, and business. 3 hours lecture.
- MATH 531 - Abstract Algebra I** **3 Credits**
Prerequisite(s): MATH 431 and permission of graduate program coordinator. Basic algebraic structures including groups, rings, fields, modules and lattices. 3 hours lecture.
- MATH 532 - Abstract Algebra II** **3 Credits**
Prerequisite(s): MATH 531, permission of graduate program coordinator. Basic algebraic structures including groups, rings, fields, modules and lattices. 3 hours lecture.
- MATH 535 - Linear Algebra I** **3 Credits**
Prerequisite(s): MATH 335 and permission of graduate program coordinator. Vector spaces and linear transformations, including inner product, matrix representations, binary and quadratic forms, eigenvectors, canonical forms, and functions of matrices. 3 hours lecture.
- MATH 536 - Linear Algebra II** **3 Credits**
Prerequisite(s): MATH 535, permission of graduate program coordinator. Vector spaces and linear transformations, including inner product, matrix representations, binary and quadratic forms, eigenvectors, canonical forms, and functions of matrices. 3 hours lecture.
- MATH 540 - Probability** **3 Credits**
Prerequisite(s): MATH 340 and permission of graduate program coordinator. Sample spaces and events, combinatorial analysis, conditional probability and stochastic independence, random variables and probability distributions, expected value and variance, probability generating functions, continuous random variables. 3 hours lecture.
- MATH 551 - Topology** **3 Credits**
Prerequisite(s): MATH 425, and permission of graduate program coordinator. Basic point-set topology, topological spaces, homeomorphisms, compactness, connectedness, separation properties, uniformities, metrizable, introductory algebraic topology, homology groups and homotopy. 3 hours lecture.
- MATH 554 - Projective Geometry** **3 Credits**
Prerequisite(s): MATH 335 and permission of graduate program coordinator. Projective planes and spaces are studied by synthetic and analytic approaches. Topics covered include the theorems of Desargues and Pappus, harmonic sequences, projectivities, coordinatization, finite planes, and conics. 3 hours lecture.
- MATH 560 - Numerical Analysis** **3 Credits**
Prerequisite(s): MATH 335, and permission of graduate program coordinator. Error analysis, interpolation and approximation theory, numerical solution of linear and nonlinear equations, numerical differentiation and integration, numerical solution of differential equations. 3 hours lecture.
- MATH 562 - General Relativity** **3 Credits**
Prerequisite(s): MATH 420 and permission from the Graduate Coordinator. An introduction to Einstein's geometric theory of gravity. Topics will include: special relativity, 4-vectors, the twin paradox, the metric tensor, non-Euclidean geometry, the equivalence principle, the gravitational redshift, geodesics, the Schwarzschild solution, and black holes. 3 hours lecture.
- MATH 564 - Ordinary Differential Equations** **3 Credits**
Prerequisite(s): MATH 335, and 420, and permission of graduate program coordinator. Linear and nonlinear equations, Green's functions, power series solutions, autonomous systems, existence and uniqueness, singularities, Sturm-Liouville systems. 3 hours lecture.
- MATH 566 - Partial Differential Equations** **3 Credits**
Prerequisite(s): MATH 335, and 420, and permission of graduate program coordinator. First order equations, separation of variables, series solutions, hyperbolic, parabolic and elliptic equations, characteristics, transform methods. 3 hours lecture.

MATH 568 - Applied Mathematics: Continuous 3 Credits

Prerequisite(s): MATH 335, and 340, and 420, and 425, and permission of graduate program coordinator. Formulation, manipulation and evaluation of mathematical models of continuous systems. Topics selected from: conservation principles and the classical equations of mathematical physics, applications of the qualitative and quantitative theory of ordinary and partial differential equations, optimization, calculus of variations, stability theory, stochastic models. 3 hours lecture.

MATH 569 - Applied Mathematics: Discrete 3 Credits

Prerequisite(s): MATH 335, and 340, and 425, and permission of graduate program coordinator. Introduction to the basic ideas of discrete mathematics and its applications. Counting principles, permutations, combinations, algorithms, complexity, graphs, trees, searching and sorting, recurrence relations, generating functions, inclusion-exclusion, the pigeonhole principle, chromatic number, eulerian chains and paths, hamiltonian chains and paths, flows in networks, finite Markov chains. 3 hours lecture.

MATH 570 - Administration and Supervision of Mathematics 3 Credits

Prerequisite(s): Permission of graduate program coordinator. Problems of organization, administration and supervision in the mathematics program of the school. Functions, duties and qualifications of the supervisor investigated. Current problems and research findings. 3 hours lecture.

MATH 571 - Curriculum Construction in Mathematics 3 Credits

Prerequisite(s): Permission of graduate program coordinator. Contemporary proposals for the mathematics of grades K through 12. Consideration is given to the problem of implementation of current recommendations. Examination is made of mathematical concepts underlying various programs. 3 hours lecture.

MATH 572 - Contemporary Teaching of Mathematics 3 Credits

Prerequisite(s): Permission of graduate program coordinator. Pedagogy, resources, and research related to the teaching of standards-based mathematics in grades 6-12. Emphasis is on creating student-centered learning environments, resources and materials for contemporary mathematics classrooms, models of effective teaching and learning, alternative assessment, appropriate uses of technology and multicultural aspects of mathematics. 3 hours lecture.

MATH 573 - Mathematics Materials for Teachers of Mathematics 3 Credits

Prerequisite(s): Permission of graduate program coordinator. The construction, adaptation and effective use of classroom materials and activities designed to enhance and expand the teaching of mathematics and mathematical thinking in the middle and high school grades with special attention given to basic commercial and simple teacher- and student-made manipulatives and models with broad use from the development of concepts and skills to their maintenance, review, and extension plus applications to problem solving. 3 hours lecture.

MATH 574 - Problem Analysis in Secondary Mathematics 3 Credits

Prerequisite(s): MATH 222 and permission of graduate program coordinator. Psychology and techniques of problem-solving. Discovery and heuristic methods. Intuitive and inductive reasoning in the solution of nonroutine problems from high school mathematics. Problem formation and solution. 3 hours lecture.

MATH 575 - Selected Topics in Mathematics Education 3 Credits

Prerequisite(s): MATH 222 and permission of graduate program coordinator. Selection of topics associated with secondary and early college years of mathematics investigated from an advanced point of view. Topics selected to give the teacher a professionalized subject matter viewpoint of such areas as algebra, geometry, number theory, real and complex analysis, probability and history of mathematics. 3 hours lecture.

MATH 576 - Research Seminar in Mathematics Education 3 Credits

Prerequisite(s): Permission of graduate program coordinator. Designed for matriculated graduate students in the mathematics education program. Students survey and analyze recent research projects. 3 hours seminar.

MATH 577 - Mathematics Education in the Elementary School 3 Credits

Prerequisite(s): Permission of graduate program coordinator. The contemporary mathematics curriculum of the elementary and middle school. The role of behavioral objectives and learning theory in curriculum development/teacher training. Related research findings. 3 hours lecture.

MATH 578 - Special Topics in Mathematics Education 3 Credits

Prerequisite(s): Permission of graduate program coordinator. Topics may be selected from areas such as assessment, cooperative learning, elementary education, fractals, graphing calculators, NCTM Standards, and other special areas of interest to mathematics educators. May be repeated once for a maximum of 6.0 credits as long as the topic is different. 3 hours lecture.

MATH 579 - Approaching School Mathematics Through Applications 3 Credits

Prerequisite(s): Permission of graduate program coordinator. Topics in middle grade and secondary mathematics are explored with an emphasis on their application to both traditional and more recently developed areas. Applied problems are used to motivate mathematical topics, and mathematical knowledge is used to explore solutions to applied problems. 3 hours lecture.

MATH 580 - Combinatorial Mathematics 3 Credits

Prerequisite(s): MATH 222 and graduate program coordinator's permission. Arrangements and selections, binomial coefficients, Stirling numbers, generating functions, recurrence relations, inclusion-exclusion, Polya enumeration formula, combinatorial graph theory, combinatorial geometries. 3 hours lecture.

MATH 581 - Graph Theory 3 Credits

Prerequisite(s): MATH 222 and MATH 335 and graduate program coordinator's permission. Graphs, digraphs, and trees. Connectivity, separability, planarity, and colorability. Cliques, independent sets, matchings, flows and tours. Graphs as mathematical models; graph algorithms. 3 hours lecture.

MATH 584 - Operations Research 3 Credits

Prerequisite(s): MATH 425 and STAT 440 and permission of graduate program coordinator. An in-depth study of one or at most two topics in operations research, selected from linear programming and game theory, linear and nonlinear programming, queuing theory, inventory theory, simulation models. 3 hours lecture.

MATH 585 - Fundamentals of Scientific Computing 3 Credits

Prerequisite(s): MATH 420 and permission of the Graduate Program Coordinator. Special fee. Theory and implementation of mathematical computing techniques. This course will present basic programming and graphing techniques to analyze mathematical models. Students will learn basic algorithm design, programming paradigms, simulation techniques, visualization software, and typesetting software for science and mathematics. 3 hours lecture.

MATH 586 - Fundamentals of Mathematical Models 3 Credits

Prerequisite(s): MATH 585 and STAT 583 and permission of graduate program coordinator. Special fee. The course investigates meaningful and practical problems across various industry related disciplines including mathematical sciences, engineering, economics, operation research and life sciences. Students will learn how to identify problems, construct or select developed models, collect and analyze data, and draw appropriate conclusions. The development of appropriate mathematical models used to study applied case problems originating from industry interest will be stressed as well as interpretation of mathematical results in that context. 3 hours lecture.

MATH 587 - Fundamentals of Optimization 3 Credits

Prerequisite(s): MATH 585 and STAT 583 and permission of Graduate Coordinator. Introduction to applied optimization in various settings, both continuous and discrete. Topics selected from linear programming, non-linear programming, network optimization models, and feedback control with an emphasis on applications to business management, economics, game theory, and finance. The course will be team-taught, with the various areas of optimization introduced by faculty with expertise in that field. 3 hours lecture.

MATH 588 - Professional Science Master Mini-Projects 6 Credits

Prerequisite(s): MATH 585, MATH 586, MATH 587, STAT 583 and permission of the Graduate Program Coordinator. Students working in teams will be assigned problems selected from professional case studies and may include problems of current interest supplied by collaborating industries and/or advisory board members. Solution methodology will vary from problem to problem and will require the wide breadth of mathematical tools covered in the prerequisite courses. These include discrete and continuous modeling, optimization methods, and data analysis. Central to the professional experience, students will present problem statement, solution methodology, and results during class time. Emphasis will be placed on incorporating the skills developed in the PSM plus courses. Specifically, these skills involve understanding goals, leadership and teamwork, communication skills, marketing the project, discipline, flexibility, innovation, special appropriate technologies, quality of project outcomes, ethics (as applicable), and meeting potential employer expectations. 6 hours lecture.

MATH 590 - Advanced Topics 3 Credits

Prerequisite(s): Graduate program coordinator's permission. An in-depth study of a topic or topics selected from areas such as algebra, analysis, geometry, probability and statistics, and applied mathematics, with special emphasis upon recent developments in the field. May be repeated once for a maximum of 6.0 credits as long as the topic is different. 3 hours lecture.

MATH 591 - Applied Industrial Mathematics 3 Credits

Prerequisite(s): MATH 335, MATH 425, MATH 530, STAT 330 or permission of graduate program coordinator. Formulation, modeling, and solution of mathematical problems from engineering, science and business. Topics include statistical distributions, Monte Carlo method, function fitting, transforms optimization, regression analysis, cost-benefit analysis, ordinary differential equations, partial differential equations, numerical methods, divided differences, splines, Galerkin's method, and finite elements. 3 hours lecture.

MATH 595 - Seminar 1-4 Credits

Prerequisite(s): Graduate program coordinator's permission. Guided study of selected topics in major field of interest. May be repeated once for a maximum of 6.0 credits as long as the topic is different. 1-4 hours seminar.

MATH 611 - Leadership Development in Mathematics Education 3 Credits

Prerequisite(s): Acceptance in the master's program in Teaching Middle Grades Mathematics and permission of the graduate program coordinator. Students gain experience in recognizing, acquiring, and applying key leadership characteristics in the field of mathematics education at the middle and high school grades. Specific attention is given to how teachers become stewards of best practices and active educational change agents in their schools and community and through professional development and involvement. 3 hours lecture.

MATH 690 - Independent Study in Mathematics 3 Credits

Prerequisite(s): Permission of graduate program coordinator. Departmental approval. Independent study under the direction of a faculty member, offering the opportunity to pursue topics in mathematics which may be outside the scope of regular curricular offerings or may be an extension of an existing course or courses. Approval must be obtained from the graduate coordinator and faculty advisor. May be repeated once for a maximum of 6.0 credits during the graduate program.

MATH 697 - Culminating Experience for PSM 6 Credits

Prerequisite(s): Completion of 27 credits including MATH 585 and MATH 586 and MATH 587 and MATH 588 and STAT 583 and permission of the Graduate Program Coordinator. Students will work in teams to solve problems originating in the industry or to deliver industry related case studies. Each group will produce a written report of their work and give a PowerPoint presentation summarizing their report. Projects will require background knowledge in the PSM mathematical and technical core content and the communication/business plus course training. Each project will be mentored by a PSM faculty or advisory board member. 6 hours lecture.

MATH 698 - Master's Thesis 3 Credits

Prerequisite(s): Permission of graduate program coordinator. Independent research project done under faculty advisement. Students must follow the MSU Thesis Guidelines, which may be obtained from the Graduate School. Students should take MATH 699 if they don't complete MATH 698 within the semester.

MATH 699 - Master's Thesis Extension 1 Credit

Prerequisite(s): MATH 698, permission of graduate program coordinator. Continuation of Master's Thesis Project. Thesis extension will be graded IP (In Progress) until thesis is completed, at which time a grade of Pass or Fail will be given.

MATH 740 - Technological Tools for Education in Mathematics 3 Credits

Prerequisite(s): MATH 512 or MATH 513 and matriculation in Ed.D.in Pedagogy or permission of graduate program coordinator. This course will explore the research literature on technology tools for education in mathematics and science in order to create a richer and more egalitarian learning environment. Classroom practices and state and national science and mathematics standards will be examined in light of research knowledge on technology in education. The scholarly literature on other issues related to technological literacy, such as equity, will be discussed and explored. 3 hours lecture.

MATH 741 - Historical and Multicultural Foundations of Mathematical Thought 3 Credits

Prerequisite(s): Matriculation in Ed.D.in Pedagogy, permission of graduate program coordinator. This course will trace the historical evolution of major themes and concepts in mathematics and the role and influence of various cultures in the development of these ideas. Multicultural perspectives will survey the impact of non-European cultures, including those of Asia, Africa, the Americas, and the Middle East, on the development of mathematical thought. The course will also trace major curriculum reform movements in the teaching and learning of mathematics throughout the United States during the nineteenth and twentieth centuries and their impact on contemporary school programs. 3 hours lecture.

MATH 742 - Mathematical Modeling in the Sciences 3 Credits

Prerequisite(s): Matriculation in Ed.D.in Pedagogy. Permission of graduate program coordinator. The exploration of mathematical models in the sciences and issues related to the teaching and learning of such models. Includes the collection and analysis of data using modern technology. Discussion of curricula that emphasize modeling and current research related to interdisciplinary approaches to teaching mathematics and science. 3 hours lecture.

MATH 743 - Advanced Perspectives on High School Mathematics 3 Credits

The exploration of mathematics content related to the high school curriculum, but developed from an advanced perspective. Emphasis on multiple representations and justification. Topics may include conic sections, rates of change, and combinatorics. Pedagogy will be discussed in relation to students' learning experiences in the course. 3 hours lecture.

MATH 744 - Special Topics in Mathematics Education 3 Credits

Prerequisite(s): Admission into Ed.D in Math Education and permission of Doctoral Program Director. Topics may be selected from areas such as curriculum development, mathematics education policy, cognition in mathematics, comparative education, teacher development, assessment, perspectives on mathematical content, and student development. 3 hours lecture.

MATH 745 - The Use of Teacher Knowledge in Mathematics Teaching 3 Credits

Prerequisite(s): Matriculation in Ed.D.in Pedagogy, permission of graduate program coordinator. General and mathematics-specific domains of teacher knowledge are defined, critiqued, compared and contrasted. In addition, they are applied in analyzing and determining the domains' roles in lesson planning, responding to students' questions, addressing students' misconceptions, and assessing student understanding. The research history on teacher knowledge is examined and critiqued with an eye towards understanding the introduction and use of the domains of knowledge being employed by current educators and researchers. The role of these knowledge domains in implementing the NCTM Standards also is examined. Articles on teacher knowledge are discussed and analyzed. These ideas are employed in analyzing classroom or interview videotapes, audiotapes, and transcripts to determine the potential use of teacher knowledge as it is instantiated in more practical situations. 3 hours lecture.

MATH 746 - Designing for Mathematical Experience 3 Credits

Prerequisite(s): Permission of director of PhD program in Mathematics Education. This course focuses on the 3D design, production, and evaluation of new physical tools to support mathematics learning and/or generate powerful forms of mathematical experience. A design for learning approach is used to enrich students' images of mathematical experience and to develop their models of how learners learn mathematics in interaction with physical tools. Topics are organized around learning theories and design principles. 3 hours lecture.

MATH 790 - Independent Study in Mathematics Education 3 Credits

Prerequisite(s): Matriculation in the Ed.D. in Mathematics Pedagogy; permission of graduate program coordinator. With the guidance of a member of the doctoral faculty, students investigate topics that are outside the scope of regular course offerings. This allows doctoral candidates the opportunity to explore research topics more deeply. May be repeated for a maximum of 6 semester hours. 3 hours lecture.

MATH 811 - Mathematics Education Leadership 3 Credits

Prerequisite(s): Matriculation in Ed.D.in Pedagogy, permission of graduate program coordinator. Students will gain experience working for systemic change in educational programs and thus become capable of assuming a leadership role for such change. This course is designed to provide a long-term experience with nurturing pedagogy, leadership development, and stewardship of best practices. Candidates will work closely with faculty to develop goals and expectations for specific change in their work settings, where appropriate, then evaluate progress towards these goals. Candidates will conduct field work in this area, including experimental design, implementation, and evaluation of results. The course includes reading, seminars, and portfolio development as well as presentations from visiting faculty and other leaders in mathematics education. 3 hours lecture.

MATH 812 - Mathematical Modeling for Middle Level High School Grades 3 Credits

Prerequisite(s): Matriculation in Ed.D.in Pedagogy, permission of graduate program coordinator. This course will examine mathematical modeling as a process of identifying a problem, determining a mathematical core, working within that core, and reexamining the problem to ascertain what mathematics reveals about the original problem. Specific models related to various areas of mathematics will be explored, developed, and applied in the solution of contemporary problems, and the models will serve as unifying structures in the secondary curriculum. 3 hours lecture.

MATH 813 - Geometry for Middle and High School Grades 3 Credits

Prerequisite(s): A background in undergraduate geometry comparable to MATH 350 and matriculation in Ed.D.in Pedagogy, permission of graduate program coordinator. This course discusses specific topics from geometry, their impact on the changing geometry curriculum in the schools, their application through technology, and their connection to other areas within and outside mathematics. Examples include dimension, scaling, measurement, and fractal dimension, with their use as unifying themes that can be studied from several points of view, that make use of current visualization technology, and that can be applied across disciplines. Additional topics may be selected from finite and projective geometries, spherical and other non-Euclidean geometries. The roles these topics play in enhancing mathematical thinking and visualization skills, both in these classroom teachers and, ultimately, in the students whom these teachers teach, are emphasized. Classroom materials, activities, and techniques are discussed and developed and concepts explained and explored through various modes, such as hands-on manipulatives, interactive computer software, and graphing calculators. 3 hours lecture.

MATH 814 - Algebra and Analysis for Middle and High School Grades 3 Credits

Prerequisite(s): MATH 425 and MATH 431 and matriculation in Ed.D.in Pedagogy, permission of graduate program coordinator. Topics from algebra and analysis will be used to explore and unify a variety of topics in the changing school curriculum. For example, the topic of linear transformations can be used to motivate the connection between geometric transformations and the related algebra. Topics will be selected to provide students with the tools to approach algebra numerically with middle school students as well as more abstractly with advanced senior high school students. Other topics, such as the Fundamental Theorem of Algebra, complex numbers, sequences, and series will be used to bridge the gap between algebra and topics in analysis. Then topics from analysis will be used to build a firm foundation on the structure of various number systems such as real and complex numbers. Part of the course will be axiomatic and theoretical development in the classical sense. Applications of these theoretical results to the school mathematics curriculum and to other academic fields, such as physics, will be explored. 3 hours lecture.

MATH 815 - Critical Thinking and Cognitive Development in Mathematics 3 Credits

Prerequisite(s): Matriculation in Ed.D.in Pedagogy, permission of graduate program coordinator. Cognitive development and the application of critical thinking and problem solving strategies to the teaching and learning of mathematics. Mathematical models as unifying structures will be examined together with investigations into methods of acquiring mathematical knowledge and the nature of mathematical proof. Contemporary learning theories in mathematics will be surveyed and applied in specific classroom situations. 3 hours lecture.

MATH 816 - Mathematics Curricula 3 Credits

Prerequisite(s): Acceptance into the Ed.D program. This course will engage graduate students in important questions regarding the development, use, and adoption of mathematics curricula in the United States and elsewhere. Students will explore theoretical and historical perspectives on the definition and role of curricula and examine research on the use and impact of various mathematics curricula, including those currently being used in mathematics classrooms. They will investigate the impact of advancing technology on conceptions and delivery of mathematics curricula and explore implications for the future of mathematics education. They will also engage in a critical analysis of a particular mathematics curriculum or collection of curricula. 3 hours lecture.

MATH 821 - Mathematics Education in Higher Education 3 Credits

Prerequisite(s): EDFD 820 or EDFD 821. Discussion of issues related to mathematics education at four-year colleges, spanning introductory mathematics courses to graduate-level teacher education and research courses. Research and policy initiatives related to collegiate mathematics education will be explored. The implication of these initiatives on teaching and learning at the college-level, as well on the role of faculty, will be discussed. This course is a prerequisite for MATH 822. 3 hours lecture.

MATH 822 - Mathematics Education in Higher Education Practicum 1 Credit

Prerequisite(s): MATH 821. Students will work with a faculty member on the planning, execution, and assessment of an undergraduate course in mathematics education. The course will prepare students for teaching mathematics education at two- and four-year universities. 1 hour lecture.

MATH 825 - Research in Mathematics Education 3 Credits

Prerequisite(s): Matriculation in Ed.D.in Education with a concentration in Pedagogy (Philosophy for Children) or Ed.D.in Mathematics Pedagogy, permission of graduate program coordinator. This course will examine the nature of research in mathematics education, its designs and methodologies, and its impact on school curricula. Research studies in cognitive development, curriculum and instruction, the teaching-learning process, language and communication in mathematics classrooms, and critical contemporary issues in mathematics education will be examined, analyzed, and discussed from the perspective of the classroom teacher. 3 hours lecture.

MATH 830 - Dissertation Proposal Seminar 1-3 Credits

Prerequisite(s): Matriculation in Ed.D.in Education with a concentration in Pedagogy (Philosophy for Children) or Ed.D.in Mathematics Pedagogy; admission to candidacy, permission of graduate program coordinator. Students will work with their dissertation advisors to develop and refine their dissertation proposals. The seminar is a supplement to the formal dissertation proposal process that is outlined in the handbook. Successful completion of this course does not imply approval of the dissertation proposal. This course will be offered as pass/fail only. Cross listed with EDCO 830 and EDFD 830. 3 hours seminar.

MATH 900 - Dissertation Advisement 3-12 Credits

Prerequisite(s): Matriculation in the Ed.D. Mathematics Education program; Advancement to Candidacy. This department requires 12 credits of MATH 900. While enrolled in MATH 900, students will work with their Dissertation Chair and their Dissertation Committee. Credits are reported as IP (In Progress) while the dissertation is being written. At the conclusion of the dissertation defense, a final grade of Pass or Fail will be recorded.

MATH 901 - Dissertation Extension**1 Credit**

Prerequisite(s): 12 credits of dissertation advisement. Once students have acquired 12 credits of MATH 900 Dissertation Advisement, they must enroll in 1 credit of MATH 901 in every semester in which they intend to work on the dissertation, up to and including the semester of the defense. Credits are reported as IP (In Progress) while the dissertation is being written. At the conclusion of the dissertation defense, a final grade of Pass or Fail will be recorded. MATH 901 may be repeated until the time limitation for completion of the doctoral program as specified in the Doctoral Policy Manual has been reached. Cross listed with EDCO 901.

MATH 920 - Qualifying Examination Preparation**0.5 Credits**

Prerequisite(s): Students with EDD in Mathematics Education only.
Special fee.