MATHEMATICS EDUCATION— (MAT)

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Mathematics Education combines a modified traditional major in Math with a corollary major in Education that will provide Mathematics certification in grades 8-12. The description below specifies the requirements and electives that are needed to complete the Mathematics major as modified to meet certification needs; please see Education for a description of the requirements for the corollary major in Education.

The various disciplines within the Department of Mathematics, Physics and Computer Science are united by their reliance upon:

- methods for discovering and demonstrating patterns, and for constructing structures that exhibit, unify and illuminate these patterns;
- applications of these structures to model a wide variety of phenomena in mathematics and the sciences;
- precise language as a means to express patterns and describe structures.

The Department offers majors in Mathematics and Physics. Mathematics is the art of creating, recognizing, and analyzing abstract quantitative and geometrical structures; Physics is the study of the physical universe. Students who pursue either course of study are trained to solve theoretical and practical problems and to communicate their solutions effectively. This training provides a foundation for further graduate and professional study in many fields as well as for employment in business and industry.

Major
(B.A. degree) Thirty-three hours required. A minimum of thirty hours in Mathematics, including MAT125, 225, 301, 310, 325, 331, 335, 415, and 431. The remaining three hours in Mathematics must be chosen from courses numbered above MAT225. Allied course: CSC115.

Students with strong backgrounds in mathematics will be placed at course levels commensurate with demonstrated ability. After earning twenty-four credit hours, any student who has not completed the quantitative proficiency requirement must enroll in a course that completes this requirement and in each subsequent semester must enroll in such a course until he/she completes the course with a grade of D or better or transfers in a course deemed to satisfy the requirement. For students falling under the requirement of continuous enrollment, drops during the semester can only be approved by the MPC Department Chair or the Mathematics Program
Coordinator. For students with a math subscore on the ACT of less than 19 (or its equivalent), initial placement is in MAT115 Liberal Arts Mathematics. Exceptions to this placement can be made by the MPC Department Chair or the Mathematics Program Coordinator.

A prerequisite must be taken before the course; a corequisite may be taken before or concurrently with a course.

107. College Algebra. (3 hours) A survey of algebraic techniques and of functions. Topics include theory of equations and inequalities, graphs, transformations of functions, inverse functions, and exponential and logarithmic functions. Can be used as preparation for MAT109. Not applicable to a major or minor in mathematics. Prerequisite: ACT Math subscore of 19 or permission of the mathematics coordinator. Fall

109. Calculus for Business and the Social Sciences. (3 hours) An introductory survey of calculus, less theoretical in nature than MAT125. Topics include derivatives of algebraic, exponential, and logarithmic functions, the definite integral, and applications to business and the social sciences. Not applicable to a major or minor in mathematics. Prerequisite: Math ACT subscore of 22 or MAT107. Students with a grade of C or higher in MAT125 (or its equivalent) may not subsequently take this course for credit. Odd Springs

111. Elementary Probability and Statistics. (3 hours) An introductory study of statistics, including such topics as numerical and graphical descriptive statistics; sampling methods and design of studies and experiments; basic probability and the distribution of sampling statistics; and inferential procedures such as confidence intervals and tests of hypothesis. This course does not count toward a major or a minor in Mathematics. Prerequisite: ACT math subscore of 19 or permission of the mathematics coordinator. Fall and Spring

115. Liberal Arts Mathematics. (3 hours) An introductory mathematics class with a focus on practical applications including but not limited to: money management, basic statistics, voting and social choice, and management science. Students with a grade of C or higher in MAT109 or MAT125 (or their equivalents) may not subsequently take this course for credit. Fall and Spring

123. Precalculus. (3 hours) A survey of algebraic and trigonometric techniques and functions designed to prepare students for the study of calculus. Topics include a review of algebra, exponential and logarithmic functions, trigonometric functions, analytic trigonometry, and vectors. If time permits, systems of equations and conic sections will be introduced. Not applicable to a major or minor in mathematics. Prerequisite: Math ACT subscore of 22 or consent of instructor. Students with a grade of C or higher in MAT123 (or its equivalent) may not subsequently take MAT107
125. Calculus I. (3 hours) A study of the derivative, its applications, and an introduction to the integral. Topics include limits, continuity, techniques of differentiation, optimization, the Fundamental Theorem of Calculus, and indefinite integrals. Prerequisite: a C or better in MAT123 or high school precalculus and knowledge of trigonometric functions.

Fall

170. Special Topics in Mathematics (.5-3 hours) As needed

203. Mathematics for Elementary Education I. (3 hours) A detailed development of the mathematics taught in elementary school using a problem-solving approach. Topics include numeration, proportional reasoning, number theory, and, for whole numbers, fractions, and decimals, number sense and standard and non-standard algorithms. For elementary education majors only. Prerequisite: Sophomore standing.

Fall

204. Mathematics for Elementary Education II. (3 hours) A continuation of MAT203. A detailed development of the mathematics taught in elementary school using a problem-solving approach. Topics include further development of the real numbering system, informal geometry, probability, and statistics. For elementary education majors only. Prerequisite: MAT203.

Spring

225. Calculus II. (3 hours) A continuation of the study of the integral and a study of multivariable differentiation. Topics include techniques of integration, applications of the definite integral, vectors, partial differentiation, and Lagrange multipliers. Prerequisite: MAT125 or high school calculus.

Fall and Spring

301. Discrete Mathematics. (3 hours) An introduction to fundamental theoretical concepts of mathematics. Topics include logic, techniques of proof, elementary set theory, mathematical induction, relations and functions, counting techniques, and Boolean algebra. Corequisite: MAT225.

Fall

303. Fundamentals of Data Computing. (3 hours) This course focuses on data analysis in settings where the data is so large, dispersed or messy that machine-processing is required to gather, clean and transform it into forms suitable for analysis. We also study computer-based techniques for the analysis of such data, including machine data visualization and machine-learning. Finally we consider how the practice of reproducible research and the development of interactive web-based applications can enhance communication of the results of data analysis. Prerequisites: MAT111 or CSC115 or PSY211 or permission of the instructor.

Fall

310. Linear Algebra. (3 hours) A theoretical study of systems of linear
equations and vector spaces. Topics include matrix algebra, linear
transformations, eigenvalues and eigenvectors, determinants, and linear
programming. Prerequisites: MAT225 and 301.

325. Calculus III. (3 hours) A study of infinite series, multivariable
integration, and vector calculus. Topics include tests for convergence of
series, power series, polar coordinates, vector-valued functions, double
and triple integrals, and line integrals. Prerequisite: MAT225.

327. Introduction to Numerical Methods. (3 hours) An introduction to
the analysis and implementation of numerical methods. Topics include
number representation and errors, locating roots of equations,
interpolation, numerical differentiation, numerical integration, numerical
solution of linear systems of equations, approximation by spline functions,
numerical solution of differential equations, and the method of least
squares. Prerequisites: CSC115 and MAT301.

331. Probability Theory. (3 hours) A study of chance phenomena and
probability distributions, with applications to elementary descriptive and
inferential statistics. Topics include probability laws and elementary
combinatorics, random variables, discrete and continuous probability
distributions, the Central Limit Theorem, and basic interval estimation and
hypothesis testing. Prerequisite: MAT225.

332. Mathematical Statistics. (3 hours) A study of statistical methods
and tests of hypotheses. Topics include estimation of parameters from
both frequentist and Bayesian points of view, and linear models.
Prerequisite: MAT331.

335. Advanced Geometry. (3 hours) A rigorous but non-axiomatic
treatment of advanced geometry on the Euclidean plane, from two or more
points of view. Possible viewpoints include synthetic geometry, vector
geometry, and geometry using complex numbers. Usually additional
topic(s) will be covered, with such topics typically being drawn from
axiomatic development of elementary geometry, geometry in higher
dimensions, non-Euclidean geometries, and historical studies, especially
geometry in non-Western cultures. Prerequisites: MAT125 and 301.

343. Mathematical Modeling. (3 hours) An introduction to the study of
modeling real-world phenomena, with an emphasis on applications to
science. Topics include modeling using difference equations and
differential equations, simulation, matrix modeling and Markov chains,
and dimensional analysis. Prerequisite: MAT125 and CSC115.

345. Ordinary Differential Equations. (3 hours) A study of solution
methods and applications of ordinary differential equations. Topics
include first order equations, second and higher order linear equations, and linear systems. Additional topics are chosen from: the Laplace transform, power series techniques, Fourier series, nonlinear systems, calculus of variations. An introduction to partial differential equations may also be included. Corequisite: MAT325.

405. Complex Analysis. (3 hours) An introduction to the study of functions of one complex variable. Topics include the algebra of complex numbers, analytic functions, contour integrals, power series, the Residue Theorem, and conformal mappings. Corequisite: MAT325.

413. Number Theory and Cryptology. (3 hours) A survey of topics in elementary number theory, with an emphasis on applications to cryptology. Topics include modular arithmetic, the Chinese Remainder Theorem, the Euler phi function, pseudoprimes, and various cryptosystems, including affine substitutions, the Vigenere square, and RSA. Prerequisite: MAT301.

415. Abstract Algebra. (3 hours) A theoretical development of basic algebraic structures, with an emphasis on group theory. Topics include cyclic groups, Lagrange’s Theorem, quotient groups, and homomorphisms. Rings, integral domains, and fields are introduced. Prerequisites: MAT225 and 301.

431. Real Analysis I. (3 hours) A theoretical development of the elements of calculus. Topics include sequences, continuity, derivatives, and integrals of single-variable functions. Prerequisites: MAT225 and 301.

432. Real Analysis II. (3 hours) A continuation of MAT431. Topics include integration theory, infinite series, and series and sequences of functions. Prerequisite: MAT431.

440. Independent Study. (1-3 hours)

460. Internship. (1-3 hours) Students may receive graduation credit for internships with appropriate disciplinary content that meet the faculty-approved criteria for academic internships. Such experiences include a significant reflective component and must be supervised by a full-time member of the Georgetown College faculty. Prerequisites: consent of the supervising instructor.

470. Advanced Topics. (0.5-3 hours)