Mathematics

Department Location
Science Center – Room 324

Special Requirements
1. All mathematics majors are required to take and pass Math 200 (Introductory Seminar in Mathematics) during their first year. Students who declare mathematics as a major after their first year are required to take the course at the first available opportunity.
2. Mathematics majors are required to take a major field exam in February of their senior year. Data from this exam is used for departmental awards, recommendations, and advising.

Placement Examinations
Upon entrance to the College, all students must take the math placement exam. On the basis of performance on the placement exam, all students will be assigned to appropriate courses, such as MATH 101, 107, 115, 116, 120, 193, 211, 212, 231, 232, 324, or they may be exempted from taking a mathematics course. Placement depends on the selected major or minor in addition to performance on the placement examination.

Goals
The primary goal of the Mathematics Department is to teach all students to think logically and critically. The curriculum supports the development of higher level mathematical skills and computing expertise for students in fields such as the natural, computer, engineering, and social sciences. Furthermore, the departmental programs and activities provide opportunities for academic excellence and leadership development, which enhance a liberal arts education.

Objectives
Upon completion of the prescribed program of study in mathematics, the students should be able to
1. recognize that mathematics is an art as well as a powerful foundational tool of science with limitless applications.
2. demonstrate an understanding of the theoretical concepts and axiomatic underpinnings of mathematics and an ability to construct proofs at the appropriate level.
3. demonstrate competency in mathematical modeling of complex phenomena, problem solving and decision making.
4. demonstrate a level of proficiency in quantitative and computing skills sufficient to meet the demands of society upon educated women as global leaders.

General Core Requirements
MATH 107, 115, 193 or 120 or any higher level mathematics course may be used to satisfy the core curriculum requirement in mathematics. First-year students are placed in these courses on the basis of their performance on the mathematics placement examination.

International/Women's Studies Requirement
None

Teacher Certification
See Education Studies Program

Departmental Honors
The following criteria for Departmental Honors for Mathematics majors have been adopted by the Mathematics Department: (1) Overall GPA > 3.0, (2) GPA in major courses > 3.5, (3) No grade less than "C" in a major course, (4)* Honors thesis. Students meeting these standards may petition to graduate with Departmental Honors whether or not they are in the College's Honors Program.

*If the student is in the College's Honors Program, the honors thesis will satisfy this requirement; otherwise, a student can complete the thesis through independent study and research or can expand the Senior Seminar project into a thesis.

Departmental Honor Societies
Students who qualify may be elected to membership in the Pi Mu Epsilon Mathematics Honorary Society, Georgia Delta Chapter. This chapter is composed of students from all Atlanta University Center schools. In addition, high-achieving students may join the Beta Kappa Chi Scientific Honor Society.

Off-Campus Course Requirements
Mathematics majors and minors are expected to take all of their required and elective mathematics courses at Spelman College. In the case of a student having justifiable difficulties, the student's advisor(s) and the chair of the department will be willing to review a formal written request, which is required for a student to receive approval to take a course at another institution. This course will be approved to count toward the math major only if all parties agree. Please note:
1. No math course can be taken off campus without prior written approval.
2. Requesting approval is not a guarantee of obtaining approval.
3. A separate approved application form is needed for each mathematics course.
4. Of the entire sequence of required math courses, two (at most) such courses can receive this type of approval.
5. At most, one of Math 371/472/463/464 (or equivalent) may be taken off campus.
6. Neither a required course nor an elective may be taken off campus in a semester in which it is offered at Spelman.
7. Courses can only be taken off campus if all prerequisites have been met.
8. Courses taken in violation of the above stipulation must be successfully retaken at Spelman.

Major Requirements

A major in mathematics provides an excellent background for a variety of careers. Students have the option of selecting electives designed to prepare them for graduate study in pure mathematics, mathematics education, operations research, computer science, statistics, business administration, actuarial science or other applied mathematics areas, secondary school teaching, medical or dental school, or employment in business, government, or industry upon graduation. The Department will assist students in planning elective courses that will give maximum support to their career objectives.

The major in mathematics consists of 13 courses (at least 43 hours) in mathematics: MATH 200, 231, and 232 (or 295 and 296), 214, 233, 324, 371, 463, 487, and either 464 or 472 are required along with three approved electives above the 200 level. Elective courses at Spelman include MATH 314, 322, 355, 358, 361, 365, 366, 367, 368, 455, 456, 464, 472, 481, and PHY 305.

The Bachelor of Arts degree will be awarded in this major after the successful completion of the major cognate courses and the 13 courses (at least 43 hours) as outlined above. The Bachelor of Science degree will be awarded upon the completion of all the requirements for the bachelor of arts degree plus an additional two courses (8 credits) consisting either of 2 additional mathematics electives (8 hrs) above the 200 level or an additional year in one science (biology, chemistry, physics, or computer science).

Both degrees require successful completion of all courses with no grade lower than a "C" in those courses counted toward the 43 (54) hours for graduation. Students must make a grade of "C" or better to progress to a subsequent course.

Major Cognate Courses

A two-semester sequence of a laboratory science course (biology, chemistry, or physics) at the level of majors in that discipline (6-8 hours) and one semester of a computer science course in a high-level programming language (e.g., a C++, MatLab, or Java course such as CIS 121). Cognate courses must be completed with grades of "C" or better.

Minor Requirements

The minor in mathematics consists of one computer programming course, such as CIS 121, and five mathematics courses (at least 19 hours): MATH 231 and 232 (or 295 and 296), 214, 233, and one approved mathematics elective above the 200 level.

Course Descriptions

MATH 101 – COLLEGE ALGEBRA (4)
This course covers the fundamentals of algebra and the mathematics needed for precalculus. Topics include the real number system, algebraic expressions, linear and quadratic equations, and an introduction to functions. Prerequisite: College placement exam. **Cannot be used to fulfill the core curriculum requirement.**

MATH 107 – CONTEMPORARY MATHEMATICS (3)
An introduction to mathematics in the real world, including elementary probability and statistics, financial and consumer mathematics, with emphasis on quantitative reasoning skills and problem solving.

MATH 115 – PRECALCULUS MATHEMATICS I (3)
This course covers applications of algebra in problem solving, functions, graphs and transformations, polynomials and rational functions, exponential and logarithmic functions, and complex numbers. Prerequisite: College placement exam.

MATH 116 – PRECALCULUS MATHEMATICS II (3)
A continuation of MATH 115. Topics covered include trigonometric functions, systems of equations, matrices and determinants, sequences and series, the binomial theorem. Prerequisite: MATH 115 or college placement exam.

MATH 120 – PRECALCULUS (ACCELERATED) (4)
A fast-paced course that reviews polynomial, exponential, logarithmic, and trigonometric functions, systems of equations, and mathematical induction. A student may not receive credit for both MATH 120 and the 115-116 sequence. Prerequisite: MATH 101 or college placement exam.

MATH 193 – HONORS QUANTITATIVE REASONING AND METHODS (3)
A rigorous introduction to mathematical ideas. Varying topics are selected from the following: Set theory, logic, polynomial and rational functions, exponential and logarithmic functions, matrices, linear programming, trigonometric functions, mathematical induction, probability, and statistics. Course requires independent study papers or projects. Prerequisite: Honors Program enrollment or departmental approval in conjunction with performance at appropriate level on the college placement exam.

MATH 200 – INTRODUCTORY SEMINAR IN MATHEMATICS (0)
This seminar provides a forum for new mathematics majors to interact and learn about the major. Course topics include an introduction to mathematical software, careers in mathematics, technical writing and mathematical problem solving.

MATH 205 – GENERAL STATISTICS (4)
This course provides an introduction to statistics suitable for liberal arts students. Topics covered include descriptive statistics, graphs and charts, introduction to probability and probability distributions, sampling, hypothesis testing, and an introduction to data analysis using the computer while stressing a wide variety of applications from real-world situations. Prerequisite: MATH 107 (or 115, 116, 120, or 193). Does not count as a math elective.

MATH 211 – APPLIED CALCULUS I (4)
An introduction to the basic ideas of calculus expressly designed for biology and economics majors. Topics include functions and graphs, tangent lines, derivatives, rate of change, maxima-minima problems, exponential and logarithmic functions, integration, multivariable and calculus applications to biology and economics. Prerequisite: MATH 115 (or 120) or college placement exam.

MATH 212 – APPLIED CALCULUS II (4)
This course is a continuation of MATH 211. Topics covered include partial derivatives, graphing techniques, integration techniques, trigonometric functions, double integrals, differential equations, functions of several variables, series, and Taylor polynomials. It emphasizes on applications and problem solving in economics, biology, and other life and social sciences. Prerequisite: MATH 116 (or 120) and MATH 211, or college placement exam.

MATH 214 – LINEAR ALGEBRA AND APPLICATIONS (4)
This course is a study of systems of linear equations, vectors and matrices, determinants, vector spaces, linear transformations, eigenvalues and eigenvectors, diagonalization, orthogonality and the Gram-Schmidt algorithm, and selected applications. Emphasis is on introduction to proof techniques as well as computer implementation. Prerequisite: MATH 231 (or equivalent).

MATH 231 – CALCULUS I (4)
This course introduces single variable calculus, including limits and continuity, derivatives of algebraic and trigonometric functions, optimization, related rates of change, integration, and applications. Prerequisite: MATH 115 and 116 (or MATH 120), or college placement exam.

MATH 232 – CALCULUS II (4)
This course is a continuation of MATH 231. Topics covered include derivatives of exponential, logarithmic, and trigonometric functions, methods of integration, polar coordinates, improper integrals, de L'Hopital's rule, sequences, series, power series and Taylor polynomials. Prerequisite: MATH 231 (or 295), or college placement exam.

MATH 233 – FOUNDATIONS OF MATHEMATICS (4)
This course provides a transition to higher mathematics emphasizing logic, set theory, propositional calculus and proofs, partitions, relations and functions, and cardinality. Prerequisite: MATH 231 (or equivalent), or permission of Department Chair.

MATH 234 – DISCRETE MATHEMATICS (4)
This course examines algorithms, counting methods, recurrence relations, algorithmic analysis, graph theory, paths, spanning trees, traversal, Boolean algebra, circuits, and elementary probability. Prerequisite: CIS 121 (or equivalent). Offered spring semesters. Does not count as a math elective.

MATH 295 – HONORS CALCULUS I (4)
A rigorous treatment of introductory calculus, this course includes the study of limits and continuity, derivatives of algebraic and trigonometric functions, applications of the derivative, and integration. Independent study projects will be required. Prerequisite: MATH 116 or 120, enrollment in the Honors Program or departmental approval.

MATH 296 – HONORS CALCULUS II (4)
This course is a continuation of MATH 295. Topics covered include derivatives of exponential and logarithmic functions, methods and applications of integration, improper integration, and infinite series. Independent study projects will be required. Prerequisite: MATH 231 or 295, enrollment in the Honors Program or departmental approval.

MATH 314 – LINEAR ALGEBRA II (4)
This course is a continuation of Math 214. Topics include the theory of linear operators, canonical forms, unitary transformations, and the spectral theorem. Prerequisite: MATH 214 and 233. Offered fall of odd years.

MATH 322 – GEOMETRY (4)
This course includes varying topics chosen from finite geometries, axiomatic systems, foundations of geometry, congruences and isometries, metric problems, and non-Euclidean geometries (e.g., spherical and hyperbolic). Prerequisite: MATH 233. Offered spring of odd years. Honors elective.

MATH 324 – CALCULUS III (4)
This course is an introduction to multivariable calculus, covering parametric equations, vectors, functions of several variables, partial derivatives, multiple integrals, vector calculus. Prerequisite: MATH 232 (or 295), or college placement exam.

MATH 355 – BIOSTATISTICS (4)
A basic statistics course, it emphasizes applications of statistics in the biomedical and health sciences, statistics in the health sciences, probability distributions, statistical inference, and descriptive analysis of health statistics. It stresses use of calculators and computers. Prerequisite: A calculus course or consent of the instructor. MATH 355 offered fall of even years.

MATH 358 – MATHEMATICAL MODELS (4)
Varying topics, include linear programming models, analytical queuing models, forecasting models, and computer simulation. Corequisite: MATH 232. Offered spring of even years.

MATH 361 – THEORY OF NUMBERS (4)
An introduction to number theory, this course includes Euclid's algorithm, primes, unique factorization, linear diophantine equations, linear congruences, the Chinese Remainder Theorem, Fermat's theorem, arithmetic functions, Euler's theorem, primitive roots, quadratic congruences and quadratic reciprocity, sums of squares, and Fermat's Last Theorem. It stresses modern primality testing, factoring techniques and applications to public key cryptography. Prerequisite: MATH 233. Offered fall of odd years.

MATH 365 – DIFFERENTIAL EQUATIONS (4)
A first course in ordinary differential equations, it includes separable and exact equations, integrating factors, linear first-order equations and applications, equations with homogeneous coefficients, constant coeffi-

cient linear equations, methods of undetermined coefficients and variation of parameters, systems of equations, Laplace transforms, numerical solutions, and applications of higher-order equations and systems. Prerequisite: MATH 212, 232, or 295.

MATH 366 – NUMERICAL ANALYSIS (4)
This course is a study of the derivation and use of techniques for the numerical solution of problems involving zeros of functions, linear systems, functional approximation, numerical integration/differentiation and eigenvalues. Error analysis will also be included for each technique studied. Prerequisite: MATH 214 and MATH 212, 232, or 295. It requires computer programming skills in one language. Cross-listed with Computer Science. Offered fall of even years.

MATH 367 – APPLIED MATHEMATICS (4)
This course is a study of partial differential equations and boundary value problems with applications in physics and engineering. Special emphasis is on the use of Fourier series, Bessel functions, Legendre polynomials, and Laplace transforms in solving partial differential equations. Prerequisite: MATH 232 and 365. Offered spring of odd years.

MATH 368 – COMPLEX VARIABLES (3)
This course provides an introduction to the theory of complex variables. The major topics explored in this course are the complex plane, functions of a complex variable, differentiation, integration and the Cauchy Integral formula, sequences, power series, the calculus of residues, conformal mappings, and applications. Prerequisite: MATH 324 and either MATH 214 or MATH 233. Offered spring of even years.

MATH 371 – ABSTRACT ALGEBRA I (4)
This course is a study of algebraic structures, focusing on groups, rings, and fields, including normal subgroups, ideals, quotient groups, quotient rings, integral domains, and homomorphisms. Prerequisite: MATH 232, 214 and 233. Offered each semester.

MATH 381 / CIS 381 (4) INTRODUCTION TO GRAPH THEORY
This course is an introduction to the mathematical field of graph theory. It explores fundamental graph theoretic concepts including connectivity, graph isomorphisms, trees, matchings, planarity, graph colorings, as well as Eulerian and Hamiltonian graphs. To understand these ideas, the use of both algorithms and proof techniques is emphasized throughout the course.

MATH 394 – HONORS THESIS RESEARCH (4)
This course offers departmentally supervised research that could lead to a thesis. Required: Oral presentation of research findings.

MATH 431 – INDEPENDENT STUDY AND RESEARCH (2-4)
This course is an in-depth study of a significant topic in mathematics under the direction of a member of the mathematics faculty. The student will engage in independent study or research and meet weekly with her advisor. Required: A written paper or public talk. Prerequisite: Junior standing and consent of the Department.

MATH 455 – PROBABILITY AND STATISTICS I (4)
An introduction to the theory of probability and statistics, this course includes combinatorial methods, sample space, probability, random variables, probability distributions and densities, mathematical expectation, Chebyshev's theorem, moment generating functions, and descriptive statistics. Prerequisite: MATH 324 or departmental approval. Offered fall of odd years.

MATH 456 – PROBABILITY AND STATISTICS II (4)
This course is a continuation of MATH 455. Topics covered include sampling theory, statistical inference, estimation, testing hypotheses, decision theory, correlation and regression, goodness of fit, nonparametric statistics, and analysis of variance. Prerequisite: MATH 455. Offered spring of even years.

MATH 463 – REAL VARIABLES I (4)
This course provides a theoretical treatment of the real number system, topological properties of the real line, sequences of real numbers, and properties of continuous functions. Prerequisite: MATH 324, 214 and 233. Offered every semester.

MATH 464 – REAL VARIABLES II (4)
This course is a continuation of MATH 463. Topics covered include differentiation of functions of one variable, Riemann-Stieltjes integration,

infinite series, convergence tests, series of functions and Fourier series. Prerequisite: MATH 463. Offered each spring.

MATH 470 – SPECIAL TOPICS (1-4)
This course provides lectures on topics of current interest. The topics for a given semester are selected by the instructor offering the course and in consideration of the needs and interests of the students. Prerequisite: Consent of the instructor.

MATH 472 – ABSTRACT ALGEBRA II (4)
This course is a continuation of MATH 371 and covers additional topics in groups, rings, and fields, including the Sylow theorems and field extensions. Prerequisite: MATH 371. Offered each spring.

MATH 481 – TOPOLOGY (4)
This course is a study of the structure imposed on point sets in order to give a meaningful notion of continuity of mappings, convergence of sequences, etc. It includes metric topology of the real line and of finite-dimensional Euclidean spaces, connectedness, compactness, properties of topological spaces, and continuous mappings. Prerequisite: MATH 324 and 371. Offered fall of even years.

MATH 487 – SENIOR SEMINAR (2)
This course includes readings and weekly student lectures or student-led discussions of a variety of mathematical topics determined by the interests of the students and the instructor. It emphasizes independent research and clear exposition. A paper is required. Prerequisite: Successful completion of either 371 or 464, and senior standing or departmental approval.

MATH 491 – HONORS THESIS RESEARCH (4)
This course provides departmentally supervised research. Required: A written paper and public talk. Prerequisite: Consent of the Department.