

## COURSE LISTINGS

In planning their schedules, prospective majors should note that some advanced required courses are offered only once each year and several advanced elective courses are offered only once every other year. A rotation schedule for course offerings is available in the department office and on the departmental web site.

**Prerequisites:** Because of the nature of mathematics, the department recommends that students refrain from enrolling in any course that carries prerequisites unless these prerequisites have been completed with a grade of C or better.

## MATHEMATICS

### **MATH 100 Basic Structures of Mathematics** GER 1/B

Not open to students who have received credit for any math or stat course that satisfies the GER 1/B requirement. Not recommended for students majoring in mathematics, statistics, computer science, or natural sciences. Symbolic logic, sets, number systems, relations and operations and topics in probability and statistics. This course is a terminal course and does not serve as a prerequisite to any other course in the department

*Prereq:* : CUNY Math Proficiency

3 hrs, 3 cr.

### **MATH 101 Algebra for College Students**

Topics in algebra, graphing and functions. Includes: algebraic and graphical solutions to systems of equations and inequalities; absolute value, polynomial, rational and radical expressions and equations; complex numbers; the function concept; introduction to polynomial, rational and exponential functions and their graphs.

*prereq:* appropriate score on placement exam or exit from appropriate departmental workshop

4 hrs (2 lec, 2 lab), 3 cr.

### **MATH 102 Mathematics and Everyday Life** GER 1/B

Students will learn how to model real world problems with mathematics, and learn techniques for solving them. Topics include personal finance, statistical reasoning, probability, exponential growth, and voting theory.

*prereq:* CUNY Math Proficiency

3 hrs, 3 cr.

### **MATH 104 Mathematics for Elementary Education I** GER 1/B

Fundamental and relevant mathematics as recommended by the NCTM for prospective elementary school teachers, including problem solving, sets, logic, numeration, computation, integers and number theory. Required of students planning to teach in elementary schools. Not open to other students.

*prereq:* grade of C or better in MATH 101 or appropriate score on the placement exam

3 hrs, 3 cr.

### **MATH 105 Mathematics for Elementary Education II** GER 1/B

Continuation of MATH 104. Continuation of the content of the mathematics recommended by the NCTM for prospective elementary school teachers, including probability, statistics, plane and transformational geometry, congruence and similarity.

*prereq:* grade of C or better in MATH 104

3 hrs, 3 cr.

### **MATH 110 Topics in the Mathematical Sciences** GER 1/B

Not open to students who have completed MATH 105, 160 or 260. Intended for liberal arts or social science students. Applications of topics selected from algebra, analysis, computer science, geometry, probability and statistics.

*prereq:* college-level mathematics or statistics course

3 hrs, 3 cr.

### **MATH 111 Matrices, Vectors and Linear Programming** GER 1/B

Not open to students who have completed MATH 160 or 260. Recommended for accounting students; not recommended for students majoring in mathematics or statistics. Introduction to matrices and vectors, systems of linear equations and linear programming with applications.

*prereq:* MATH 101 or appropriate score on placement exam

3 hrs, 3 cr.

### **MATH 125 Precalculus** GER 1/B

Functions and their graphs: polynomial, rational, exponential, logarithmic and trigonometric functions; conic sections; topics in trigonometry; graphical and analytical solutions to systems of equations and inequalities. Not credited to students who have completed MATH 150 or its equivalent.

*prereq:* grade of C or better in MATH 101 or appropriate score on placement exam

4 hrs, 4 cr.

**MATH 126 Precalculus Technology Laboratory**

Students are introduced to MATHEMATICA as a tool for exploring qualitative features of functions and solving precalculus problems: simplifying algebraic expressions, solving equations, plotting functions and curves, finding and approximating zeros and solving systems of equations. MATH 126 cannot be taken for credit after a student has passed MATH 150. Students who have passed MATH 150 should register for MATH 154 to satisfy the symbolic proficiency requirement.

*prereq: grade of C or better in MATH 101 or appropriate score on placement exam; pre- or coreq: MATH 125*  
2 hrs, 1 cr.

**MATH 150 Calculus with Analytic Geometry I GER 1/B**

Limits, continuity, differentiation and integration of elementary functions and trigonometric functions, applications.

*prereq: grade of C or better in MATH 125 or appropriate score on placement exam*  
4 hrs, 4 cr.

**MATH 151 Calculus I with Symbolic Computation**

Combines MATH 150 (Calculus I) with MATH 154. Some previous experience with computers is desirable but not required.

*prereq: grade of C or better in MATH 125 or appropriate score on placement exam*  
6 hrs, 5 cr.

**MATH 154 An Introduction to Symbolic Computation**

Laboratory introduction to machine-aided computation with an emphasis on examples related to calculus. Students use a symbolic computation package to investigate and solve problems numerically, analytically and graphically. The same package is used to create reports of their results. Some previous experience with computers is desirable but not required.

*prereq: MATH 150*  
2 hrs, 1 cr.

**MATH 155 Calculus with Analytic Geometry II GER 1/B**

Differentiation and integration of transcendental functions, integration techniques, infinite sequences and series, improper integrals, polar coordinates.

*prereq: grade of C or better in MATH 150*  
4 hrs, 4 cr.

**MATH 156 Introduction to Mathematical Proof Workshop**

Techniques of proof will be introduced, among them the direct and indirect methods of proof, epsilon-delta arguments and induction. These will be applied to theorems in number theory, set theory and in differential and integral calculus.

*prereq: MATH 150; pre- or coreq: MATH 155*  
2 hrs, 1 cr.

**MATH 160 Matrix Algebra GER 1/B**

Systems of linear equations, matrices, determinants, introduction to vector spaces and linear transformations, applications.

*prereq: MATH 125 or appropriate score on placement exam*  
3 hrs, 3 cr.

**MATH 250 Calculus with Analytic Geometry III GER 3/B**

Vector geometry, dot and cross products, partial derivatives, matrices, determinants, Jacobians, multiple integration.

*prereq: MATH 155*  
4 hrs, 4 cr.

**MATH 254 Ordinary Differential Equations GER 3/B**

First-order equations, second-order linear equations and linear systems, power series solutions, transform and numerical methods, introduction to qualitative theory.

*prereq: MATH 250*  
3 hrs, 3 cr.

**MATH 255 Vector Analysis GER 3/B**

Line and surface integrals, Green's Theorem, divergence theorem, Stokes' Theorem, generalized coordinates.

*prereq: MATH 250*  
3 hrs, 3 cr.

**MATH 260 Linear Algebra GER 3/B**

Vector spaces, linear transformations, canonical forms, inner product spaces, bilinear forms, applications.

*prereq: MATH 156; pre- or coreq: MATH 250*  
4 hrs, 4 cr.

**MATH 261W Mathematics in Human History** GER 2/B

A historical treatment of themes in mathematics, probability and statistics, with applications in the arts and sciences. Roots of mathematics in non-Western cultures and contributions of women and minorities are included.

*prereqs:* ENGL 120, *college-level mathematics course beyond MATH 101*

*3 hrs, 3 cr.*

**MATH 275 Intermediate Symbolic Logic** GER 3/B

Symbolization of statements in sentential and predicate notation, sentential derivations, interpretations, predicate derivations through logic of identity and definite descriptions. Cross-listed as PHIL 275.

*prereqs:* MATH 156

*3 hrs, 3 cr.*

**MATH 295 Intermediate Topics in Mathematics** GER 3/B

May be repeated as topics vary, but not more than twice. Topics to be studied in any given term will be announced prior to registration.

*prereqs:* MATH 150; *additional prereqs depend on specific course offered*

*3 hrs, 3 cr.*

**MATH 301 Mathematical Methods for the Physical Sciences** GER 3/B

The solution of linear partial differential equations and boundary value problems. Solution techniques such as separation of variables, Fourier series, Green's functions and Laplace transforms are covered. These are applied to several equations which occur in physical applications such as the heat equation, the Laplace equation and the wave equation. Crosslisted as PHYS 301.

*prereq:* MATH 254

*3 hrs, 3 cr.*

**MATH 311 Abstract Algebra I** GER 3/B

Introduction to the theory of groups and rings.

*prereq:* MATH 260

*3 hrs, 3 cr.*

**MATH 312 Abstract Algebra II** GER 3/B

Elements of Galois theory, construction with ruler and compass, advanced topics in ring theory and linear algebra.

*prereq:* MATH 311

*3 hrs, 3 cr.*

**MATH 313 Theory of Numbers** GER 3/B

Congruences, quadratic residues, elementary Diophantine analysis, continued fractions, sums of squares.

*prereq:* MATH 260

*3 hrs, 3 cr.*

**MATH 331 Geometries** GER 3/B

Topics in affine and projective geometry and/or topics in differential geometry.

*prereq:* MATH 260

*3 hrs, 3 cr.*

**MATH 340 Topology** GER 3/B

Metric and topological spaces, continuity, homeomorphisms, compactness, connectedness, homotopy, fundamental group.

*prereq:* MATH 351

*3 hrs, 3 cr.*

**MATH 351 Mathematical Analysis I** GER 3/B

Rigorous treatment of foundations of calculus, including topology of real line and higher dimensional spaces. Basic results on continuous functions.

*prereqs:* MATH 250, 260

*3 hrs, 3 cr.*

**MATH 352 Mathematical Analysis II** GER 3/B

Integration, sequences and series, uniform convergence, differentiation of functions of several variables, inverse and implicit function theorems, formula for change of variables.

*prereq:* MATH 351

*3 hrs, 3 cr.*

**MATH 353 Introduction To Complex Variables** GER 3/B

Complex numbers, analytic functions, elementary functions, contour integrals, Cauchy integral theory, series.

*prereqs:* MATH 156, 255

*3 hrs, 3 cr.*

**MATH 354 Dynamical Systems and Chaos** GER 3/B

Linear flows, qualitative theory of low-dimensional nonlinear systems, introduction to chaos in discrete one-dimensional dynamical systems.

*prereqs:* MATH 250, 260

*3 hrs, 3 cr.*

**MATH 370 Mathematical Logic** GER 3/B

A survey of the central results and techniques of metalogic, principally mathematical induction, the soundness and completeness of theorems for first-order logic, the Skolem Theorem and Church's Theorem on undecidability. Cross-listed as PHIL 375.

*prereq:* MATH 260 *or perm instr.*

*3 hrs, 3 cr.*

**MATH 371 Fundamental Concepts of Modern Mathematics** GER 3/B

Axiomatic approach to set theory: axiom of choice, Zorn's Lemma, transfinite arithmetic.

*prereqs: two of the following:* MATH 260, 311, 351, 352

*3 hrs, 3 cr.*

**MATH 376W Philosophy of Mathematics** GER 3/B

Study of such issues as the nature of demonstration or proof and the nature of mathematical knowledge and mathematical objects such as numbers and sets. Cross-listed as PHIL 376.

*prereqs:* ENGL 120; PHILO 101; MATH 275

*3 hrs, 3 cr.*

**MATH 385 Numerical Methods I** GER 3/B

Accuracy and precision, convergence, iterative and direct methods. Topics selected from: solution of polynomial equations and linear systems of equations, curve fitting and function approximation, interpolation, differentiation and integration, differential equations.

*prereq:* MATH 250 *and* MATH 260 *or permission of the instructor.*

*3 hrs, 3 cr.*

**MATH 391, 392, 393 Independent Study in Mathematics** GER 3/B

Open to Jr/Sr only. Independent study and reading under direction of faculty member.

*prereq: perm dept.*

*1-3 hrs, 1-3 cr.*

**MATH 395 Advanced Topics in Mathematics** GER 3/B

Topics to be studied in any given term will be announced prior to registration. May be repeated as topics vary, but not more than twice.

*prereqs:* MATH 250, 260; *additional prereqs depend on specific course offered*

*3 hrs, 3 cr.*

**MATH 454 Calculus on Manifolds** GER 3/B

Functions on Euclidean space, implicit function theorem, Fubini's Theorem, integration on chains and manifolds.

*prereq:* MATH 352

*3 hrs, 3 cr.*

**MATH 485 Numerical Methods II** GER 3/B

Advanced topics in numerical solutions to partial differential equations, finite element method, von Neumann stability analysis, finite difference method. Examples from computational fluid dynamics and structural mechanics.

*prereq:* MATH 385 *or permission of the instructor.*

*3 hrs, 3 cr.*

**MATH 490 Honors Seminar** GER 3/B

*prereqs:* MATH 311, 351, *perm dept.*

*3 hrs, 3 cr.*

## STATISTICS

### **STAT 110 Selected Topics in Elementary Probability and Statistics as Applied to Popular Science and Current Events** GER 1/B

Topics to be studied in any given term will be announced prior to registration. This course does not serve as a prerequisite for any other mathematics or statistics course. This course is a topics course that serves as an introduction to selected topics in probability and statistics with applications to the real world.

*prereq: CUNY Math Proficiency*

*3 hrs, 3 cr.*

### **STAT 113 Elementary Probability and Statistics** GER 1/B

Not open to students who have completed STAT 213 or PSYC 248. Not credited for majors in statistics or mathematics unless minor is elementary education. An introduction to applied statistics and statistical computing. Hands-on data analysis. Graphical inference. The five number summary, box plots, scatterplots, normal probability plots. Elementary probability. Statistical estimation and hypothesis testing. Linear regression. Students are expected to analyze real data sets and write reports. Students who have taken calculus or place into calculus by the placement exam should take STAT 213 instead of STAT 113.

*prereq: A grade of C or better in MATH 101 or appropriate score on placement exam; pre or co-req: ENGL 120.*

*3 hrs, 3 cr.*

### **STAT 212 Discrete Probability** GER 1/B

Combinations, permutations, discrete probability. Characteristics of probability distributions. Model building. Additional topics like sampling, random walks, or game theory will be introduced from time to time.

*prereq: MATH 125 or STAT 113 or appropriate score on placement exam*

*3 hrs, 3 cr.*

### **STAT 213 Introduction to Applied Statistics** GER 1/B

Familiarity with the Windows computing environment encouraged. Sampling, estimation, tests of hypotheses, including one- and two-sample t-tests, two- and three-way tables for nominal and ordinal data, linear regression, analysis of variance through two-way with interaction, appropriate statistical software.

*prereq: MATH 125 or appropriate score on placement exam.*

*3 hrs, 3 cr.*

### **STAT 214 Data Analysis Using Statistical Software** GER 3/B

Familiarity with the Windows computing environment encouraged. Analysis of variance, simple and multiple regression, nonparametric statistics, statistical model building.

*prereqs: STAT 213 or MATH 125 and STAT 113 with grade of C or better in each course*

*3 hrs, 3 cr.*

### **STAT 220 Statistical Analysis in Forensics**

A second course in probability and statistics and the evaluation of evidence in the forensic sciences.

*prereq: STAT 212 and either STAT 213 or 113 by permission of instructor. One of the above, i.e., STAT 212 or STAT 213 or STAT 113, by permission of instructor may be taken as a coreq.*

*3 hrs, 3 cr.*

### **STAT 295 Intermediate Topics in Statistics** GER 3/B

Topics to be studied in any given term will be announced prior to registration. May be repeated as topics vary, but not more than twice.

*prereqs: STAT 213 or STAT 113 and MATH 125; additional prereqs depend on specific course offered*

*3 hrs, 3 cr.*

### **STAT 311 Probability Theory** GER 3/B

Combinatorics, distribution theory for discrete and continuous random variables, central limit theorems.

*prereq: MATH 250*

*3 hrs, 3 cr.*

### **STAT 312 Stochastic Processes** GER 3/B

Discrete and continuous stochastic processes including Markov chains, birth processes, queues and Brownian motion.

*prereq: STAT 311*

*3 hrs, 3 cr.*

### **STAT 313 Introduction to Mathematical Statistics** GER 3/B

Estimation, hypothesis testing, confidence limits for normal, binomial, Poisson and exponential random variables.

*prereq: STAT 311*

*3 hrs, 3 cr.*

**STAT 319 Bayesian Statistical Inference in the Sciences** GER 3/B

Fundamental principles and techniques of probability, statistical inference and data analysis, as pertains to the sciences, especially bioinformatics. Random variables and their distributions. Central limit theorem. Conditional probability, Markov chains and Hidden Markov Models. Bayesian statistical paradigm and inference using Markov chain Monte Carlo. Computer simulations and data analysis.

*prereq:* MATH 155; *at least one of* STAT 212, STAT 213 *or* STAT 214 (*or permission of instructor*). *Prerequisites waived for students who have passed* STAT 311. *Familiarity with matrix algebra (at the level of MATH 160) and with the Windows computing environment are encouraged.*  
3 hrs, 3 cr.

**STAT 351 Advanced Biometrics** GER 3/B

A second course in statistics covering quantitative methods applicable in the life sciences. Topics include experimental design, life table analysis, ethical issues, survival analysis, logistic regression and Cox regression. Linear algebra recommended but not required.

*prereqs:* *math at level of* MATH 125, STAT 113, 213 *or equiv. intro. statistics course*  
3 hrs, 3 cr.

**STAT 391, 392, 393 Independent Study** GER 3/B

Open to Jr/Sr majors only. Independent study in which a topic of interest is selected by the student. The study is carried out under the direction of a faculty member.

*prereq:* *perm dept.*  
1-3 hrs, 1-3 cr.

**STAT 395 Advanced Topics in Statistics** GER 3/B

Topics to be studied in any given term will be announced prior to registration. May be repeated as topics vary, but not more than twice.

*prereqs:* STAT 311; STAT 312 *or* 313; *additional prereqs depend on specific course offered*  
3 hrs, 3 cr.

**STAT 486 Elements of Visualization** GER 3/B

The structure and purpose of visualization systems; includes fully developed examples from statistics and applied mathematics. Final project required.

*prereq:* MATH 385 *or* CSI 385 *or* PHYS 385, *or all of* MATH 160, MATH 250 *and* STAT 213  
3 hrs, 3 cr.