

# DEPARTMENT OF MATHEMATICS, COMPUTER SCIENCE & PHYSICS

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The bachelor's degree program in mathematics is designed to give the fundamental training necessary to prepare students to do graduate work in mathematics, to become teachers in the secondary schools or to take advantage of the employment opportunities that exist in industry, business and education. Mathematics courses provide all students with some understanding of mathematics and its importance to civilization. In addition students of the sciences are given the mathematical basis essential for their disciplines.

The bachelor's degree program in computer information systems provides practical hands-on experience with programming projects, database design, and network management; experience with team-oriented projects; and the intellectual basis for understanding networks and database systems.

Courses in physics help students learn the ways of nature through study of the natural sciences. The department's philosophy holds that an understanding of the major principles of physics leads to a better understanding of our world and a greater responsibility to it; that women should be represented equally with men in all aspects of scientific research, technology, and teaching; and that an understanding of physics assists in the confrontation of many of the environmental issues facing human civilization.

The department encourages students to pursue undergraduate research projects with a faculty member in any of the disciplines.

Any student intending to enter MA103 Introduction to Statistical Thinking, MA106 Modern Mathematical Concepts II, MA109 College Algebra, MA110 Precalculus, or MA115 Calculus I must take a departmental examination if they do not have the specified course prerequisite. Placement in these courses will be recommended on the basis of the results of this examination.

## New Jersey Teaching Credentials

The New Jersey certifications below are available for students earning the B.A. in Mathematics:

- Early Childhood Education (P–3) with Teacher of Students with Disabilities Endorsement
- Elementary Education (K–6) with Teacher of Students with Disabilities Endorsement, & with option for Mathematics Middle School Endorsement
- Teacher of Mathematics (K–12) with Teacher of Students with Disabilities Endorsement
- Teacher of English as a Second Language (ESL) with Teacher of Students with Disabilities Endorsement

For required professional courses in education, please refer to the Education (<http://catalog.georgian.edu/undergraduate/school-education/>) section of the catalog.

## Programs Majors

- Computer Information Systems, B.A. (<http://catalog.georgian.edu/undergraduate/school-arts-sciences/mathematics-computer-science-physics/computer-information-systems-ba/>)
- Mathematics, B.A. (<http://catalog.georgian.edu/undergraduate/school-arts-sciences/mathematics-computer-science-physics/mathematics-ba/>)

## Minors

- Computer Information Systems, Minor (<http://catalog.georgian.edu/undergraduate/school-arts-sciences/mathematics-computer-science-physics/computer-information-systems-minor/>)
- Mathematics, Minor (<http://catalog.georgian.edu/undergraduate/school-arts-sciences/mathematics-computer-science-physics/mathematics-minor/>)

## Courses

### Mathematics (MA)

#### MA103 Introduction to Statistical Thinking (3.0 Credits)

A broad introduction to the use and misuse of statistics. Types of variables, descriptive statistics. Tabular and visual display of data. Sampling and polling. Elements of probability. Making inferences from samples. Estimation. Hypothesis testing. Use of computer software to display and analyze data. A student who has passed MA331 with a grade of C or better may not subsequently receive credit for MA103.

Prerequisite(s): an appropriate placement score, or a college math course with a grade of C or better.

#### MA106 Modern Mathematical Concepts II (3.0 Credits)

Material covered will be selected from the following topics: Algebra-based problem solving, linear and quadratic equations, inequalities, variation, graphs, functions, geometry, measurement, counting methods, statistics, the relation between algebra and geometry. A student who has passed an MA course numbered 115 or higher with a grade of C or better may not subsequently receive credit for MA106.

Prerequisite(s): an appropriate placement score, or a college math course with a grade of C or better.

#### MA109 College Algebra (3.0 Credits)

An introduction to real-valued functions and their graphs including polynomial, rational, exponential and logarithmic functions; composite and inverse functions; theory of equations; systems of equations and inequalities. A student who has passed an MA course numbered 115 or higher with a grade of C or better may not subsequently receive credit for MA109.

Prerequisite(s): an appropriate placement score, or a college math course with a grade of C or better.

#### MA110 Precalculus (3.0 Credits)

Plane and analytic geometry—lines, translation of axes; functions and graphs (with and without graphing calculators), translation of graphs, analytic trigonometry, exponential functions, inverse functions (including inverse trigonometric functions and logarithmic functions), absolute value inequalities. A student who has passed an MA course numbered 115 or higher with a grade of C or better may not subsequently receive credit for MA110.

Prerequisite(s): MA109 with a grade of C or better, or placement.

**MA115 Calculus I (4.0 Credits)**

Limits and their properties, continuity, derivatives and their applications, integrals, Fundamental Theorem. These will be applied to algebraic, trigonometric, exponential, and logarithmic functions. 5 hours lecture. Prerequisite(s): MA110 with a grade of C or better; or placement into MA115.

**MA116 Calculus II (4.0 Credits)**

Applications of the definite integral, techniques of integration, infinite sequences and series, tests for convergence, Taylor's Theorem, power series. 5 hours lecture. Prerequisite(s): MA115 with a grade of C or better.

**MA209 Linear Algebra (3.0 Credits)**

Vectors, matrices, linear equations, real vector spaces, determinants, linear transformations and matrix representations, Euclidean spaces, eigenvalues and eigenvectors. Prerequisite(s): MA110 with a grade of C or better; or placement into MA115 or above.

**MA210 Discrete Mathematics (3.0 Credits)**

Set theory, mathematical logic, logic networks, mathematical induction; relations and functions; combinatorial analysis; graph theory. Prerequisite(s): MA110 with a grade of C or better; or placement into MA115 or above.

**MA215 Calculus III (4.0 Credits)**

Polar coordinates, vectors and vector-valued functions, surfaces in space, functions of several variables, partial derivatives, gradients, multiple integrals. 5 hours lecture. Prerequisite(s): MA116 with a grade of C or better.

**MA216 Vector Calculus (3.0 Credits)**

Analytic geometry in three dimensions, spherical and cylindrical coordinate systems, vector fields, implicit functions, line and surface integrals, Green's Theorem, divergence theorem, Stokes' Theorem. Prerequisite(s): MA215 with a grade of C or better.

**MA218 Differential Equations (3.0 Credits)**

Differential equations of the first order; linear differential equations of higher order; applications to the physical sciences. Systems of linear differential equations, series solutions; the Laplace transform. Prerequisite(s): MA116 with a grade of C or better.

**MA304 Topics in Mathematics (1.0 Credits)**

A specific topic not offered as a formal course during the given semester. Prerequisite(s): approval of instructor.

**MA311 Introduction to Abstract Algebra I (3.0 Credits)**

An introduction to basic algebraic structures; mappings and operations, permutations, properties of groups, equivalence, congruence, divisibility, direct products and isomorphisms. 4 hours lecture. Prerequisite(s): Grade of C or better in MA209, MA210, and MA215.

**MA312 Introduction to Abstract Algebra II (3.0 Credits)**

More algebraic structures; rings, integral domains, fields, polynomials over a field, quotient groups and rings and homomorphisms. 4 hours lecture. Prerequisite(s): MA311 with a grade of C or better.

**MA321 Foundations of Geometry (3.0 Credits)**

An axiomatic treatment and critique of Euclidean geometry. Hilbert's axioms of connection, order, parallels, congruence and continuity. Extension of Euclidean geometry to affine and projective geometry. Prerequisite(s): Grade of C or better in MA209 and MA210.

**MA331 Probability & Statistics I (3.0 Credits)**

Basic probability theory in both discrete and continuous sample spaces, random variables and their distribution functions, expectation and variance, covariance and correlation, and the central limit theorem. Prerequisite(s): Grade of C or better in MA116 and MA210, or permission of department chair.

**MA400 Math for Secondary School Teachers (3.0 Credits)**

A capstone course for future secondary school teachers designed to strengthen understanding of secondary school content in the context of the college mathematics curriculum. Emphasis on alternate methods of problem solving, unifying mathematical themes, the historical context of the development of mathematical ideas, the use of technology in teaching mathematics, correct mathematical communication, and methods of making study of mathematics relevant, dynamic and enriching. Prerequisite(s): MA215, MA311, and MA312.

**MA401 Introduction to Analysis (3.0 Credits)**

Real number axioms, sequences, completeness, compactness, continuity, uniform continuity, the derivative, the Riemann integral and sequences of functions. 4 hours lecture. Prerequisite(s): Grade of C or better in MA209, MA210, and MA215.

**MA404 Complex Analysis (3.0 Credits)**

The complex plane and the theory of analytic functions; mapping by elementary functions. Complex integration; series; residues and poles; conformal mapping. Offered on application. Prerequisite(s): Grade of C or better in MA209, MA210, and MA215; or permission of instructor.

**MA414 Research Problem in Mathematics (1.0 Credits)**

Students specializing in mathematics may prepare a research paper with the consent of the department. This may be an historical approach to a known problem, or an original approach to a problem arising from course work. Offered on application. Students may register and receive 1 to 4 credits more than once; students may not exceed a total of 6 credits toward the major.

**MA415 Internship/Externship Program (1.0 Credits)**

Students have the opportunity to work in an industrial or advanced academic research atmosphere. Credit will be determined by the length of the experience, with a minimum of 40 hours per credit. Prerequisite(s): MA215 and junior or senior status.

**MA433 Numerical Analysis (3.0 Credits)**

Methods of obtaining numerical solutions to various types of mathematical problems. Numerical solutions of systems of linear and nonlinear equations; interpolation; least squares approximations; numerical differentiation and integration; introduction to numerical methods of differential equations. Programs will be assigned illustrating these methods. Prerequisite(s): MA116 and CS123; or permission of instructor.

## Computer Science (CS)

**CS105 Computer Literacy (3.0 Credits)**

An introduction to computers and computer applications intended for non-Computer Science majors. Explore computer concepts and terminology, computer hardware and software, operating systems, the Internet, the Web, computer ethics, and security and privacy. Includes hands-on experience with Microsoft Office 2007 word processing (Word), spreadsheet (Excel), database (Access), presentation graphics (PowerPoint) and communication programs.

**CS111 Foundations Of Computer Science (3.0 Credits)**

A survey of fundamental concepts in computer science. Covers a wide variety of topics including algorithms, automata, language translation, digital logic, machine organization, networking basics and introductory software engineering. This course will be ideal for anyone who wants a broad overview of what computer science is about. Many advanced topics will be introduced from an elementary perspective.

**CS120 Introduction to Python (1.0 Credits)**

An introduction to the Python language, which is widely used for analyzing numerical data and text. This 7.5-week course will cover the concept of a computer program, variables, flow control statements, arrays, strings, dictionaries, functions, and file I/O. Python will be applied to solve problems in compound interest and word counts. Open to all majors. Course may not be used for credits required toward the CIS major.

Prerequisite(s): Placement.

**CS123 Computer Programming I (4.0 Credits)**

An introductory course using the computer language C++. Includes general computer concepts, C++ statements, selection structures, looping, functions, arrays, pointers, and classes. Students will design and code programs to run on their laptops or online.

Prerequisite(s): Placement

**CS126 Computer Programming II (3.0 Credits)**

Continues the introduction to programming begun in CS123 with an emphasis on object-oriented design principles and programming language features that support object orientation. C++ or another object-oriented language will be used for projects throughout the course. Also includes coverage of tools for managing large software projects.

Prerequisite(s): A grade of C or higher in CS123.

**CS212 Data Analytics for Business (3.0 Credits)**

This course studies methods for data visualization, and methods for finding relationships in numerical data or textual data using such techniques as regression analysis, logistic analysis, clustering, and K nearest neighbors. Excel, Python, and other freely available software packages will be used to analyze a variety of business operational and strategic problems. Open to all majors. This course is cross-listed with IS312.

Prerequisite(s): CS120 or CS220

**CS220 Python Programming (3.0 Credits)**

A first course in Python programming including variables and data types, flow control statements, arrays, strings, dictionaries, and list comprehensions. Python will be applied to solve problems in network modelling and machine learning. Students will also learn to display data and algorithmic results using library functions.

Prerequisite(s): A grade of C or higher in CS123.

**CS225 Computer Architecture (3.0 Credits)**

Digital computer systems, representation of data, CPU architecture, assembly language programming techniques, comparative machine architectures, assemblers, loaders and operating systems. Short programs to be written in assembly language will be assigned.

Prerequisite(s): CS123.

**CS227 Data Structures (3.0 Credits)**

Arrays, stacks, queues, linked lists, trees, graphs, searching and sorting algorithms, hashing and recursion principles. An object-oriented programming language such as C++ will be used in writing programs illustrating the implementation of the above concepts on the computer.

Prerequisite(s): CS123 and CS126, or approval of instructor.

**CS231 Introduction to Database Systems (3.0 Credits)**

Comparison of hierarchical, network and relational data models; the three levels of database architecture; function oriented vs. data-oriented system development; conceptual data modeling-entities, attributes, specialization, relationships, cardinality, keys; the relational model and normalization; using relational algebra to answer queries; database security and system recovery.

Prerequisite(s): CS123.

**CS306 Topics in CS or CIS (3.0 Credits)**

A specific topic not offered as a formal course during the given academic semester. Offered on application.

Prerequisite(s): approval of instructor.

**CS326 Survey of Networks & Telecommunications (3.0 Credits)**

Network architectures, topologies and protocols, operation of bridges, routers and gateways, network performance analysis, privacy, security, reliability, configuration of LAN and WAN networks, communication standards, and intranet and internet.

Prerequisite(s): CS225 or instructor permission.

**CS327 Computer Network Administration (3.0 Credits)**

Combines practical experience with technical understanding. Overview of TCP/IP, protocols, routing, setup, creating and administrating accounts, managing resources, printing environment, server architecture, installations, configurations, security. Hands-on experience with system administration of Windows and Linux. 2 hours lecture, 2 hours laboratory.

Prerequisite(s): CS326.

**CS414 Research Problem in CS or CIS (1.0 Credits)**

This course provides students with an opportunity to participate in an independent research project under the guidance of a faculty member. This may be a historical approach to a known problem or an original approach to a problem arising from coursework. Students may register and receive 1 to 4 credits more than once; students may not exceed a total of 6 credits toward the major.

**CS415 Internship (1.0 Credits)**

Students have the opportunity to work in an industrial, nonprofit, or advanced academic research atmosphere. Credit will be determined by the length of the experience, with a minimum of 40 hours per credit. Course will be graded as Pass/Fail. Students may register and receive 1 to 4 credits more than once; may not exceed a total of 8 credits.

Prerequisite(s): CS227

**CS450 Applications Project (3.0 Credits)**

A faculty-directed, hands-on experience for advanced CS and CIS students. The nature of each project will be determined by current student and faculty interests. Some possible projects involve relational database design, web programming, or network design. This course provides an open-ended mechanism by which students may gain practical, team-oriented experience at an advanced level prior to graduation.

Prerequisite(s): any CS course level 200 and above.

## Physics (PH)

**PH111 Physics in Everyday Life I (4.0 Credits)**

An introduction to the basic laws of physics experienced in our everyday environment and in this world of technology. May be taken before or after PH112. 3 hours lecture, 3 hours laboratory.

**PH112 Physics in Everyday Life II (4.0 Credits)**

An introduction to the basic laws of physics experienced in our everyday environment and in this world of technology. May be taken before or after PH111. 3 hours lecture, 3 hours laboratory.

**PH115 College Physics I (4.0 Credits)**

Fundamental concepts and methods of classical physics, including Newtonian mechanics, electricity, magnetism, thermodynamics, sound and light waves, with an introduction to contemporary physics. Trig-based course. PH115 must be taken before PH116. 3 hours lecture, 3 hours laboratory.

Prerequisite(s): MA110 or math placement or permission of math chairperson.

**PH116 College Physics II (4.0 Credits)**

Fundamental concepts and methods of classical physics, including Newtonian mechanics, electricity, magnetism, thermodynamics, sound and light waves, with an introduction to contemporary physics. Trig-based course. 3 hours lecture, 3 hours laboratory.

Prerequisite(s): PH115.

**PH121 University Physics I (4.0 Credits)**

Fundamental concepts and methods of classical physics, including Newtonian mechanics, electricity, magnetism, thermodynamics, sound and light waves, with an introduction to contemporary physics. PH121 must be taken before PH122. 3 hours lecture, 3 hours laboratory.

Prerequisite(s): MA115.

**PH122 University Physics II (4.0 Credits)**

Fundamental concepts and methods of classical physics, including Newtonian mechanics, electricity, magnetism, thermodynamics, sound and light waves, with an introduction to contemporary physics. 3 hours lecture, 3 hours laboratory.

Prerequisite(s): PH121.

**PH315 Topics in Physics (3.0 Credits)**

Explore a topic in physics. Lecture and/or lab for 3 or 4 credits. Offered on application.

Prerequisite(s): Approval of instructor.

**PH334 Astronomy & Cosmology (4.0 Credits)**

Study of the concepts of astronomy and cosmology. Topics include evolution of our concept of the universe from Ptolemaic beliefs to modern cosmology; space exploration and the instruments through which the wonders of the universe are revealed to us. Laboratory will include outdoor/telescopic observations, weather permitting. 3 hours lecture, 3 hours laboratory.

**PH337 Physics of Meteorology (4.0 Credits)**

A study of the physics of meteorology and dynamic nature of our atmosphere, the physical processes that shape weather and climate and the factors that control prediction of the weather. 3 hours lecture, 3 hours laboratory.

**PH370 Research Project (1.0 Credits)**

Research project in physics with a physics faculty member. Research areas include x-ray diffraction, x-ray fluorescence spectrometry, optical properties of solids, holography and solid state (condensed matter) physics. One to four semesters, 1–4 credits per semester. Only 8 credits applied to the major. PH370, PH371 taken as a junior; PH470, PH471 taken as a senior. Open to all science majors.

**PH371 Research Project (1.0 Credits)**

Research project in physics with a physics faculty member. Research areas include x-ray diffraction, x-ray fluorescence spectrometry, optical properties of solids, holography and solid state (condensed matter) physics. One to four semesters, 1–4 credits per semester. Only 8 credits applied to the major. PH370, PH371 taken as a junior; PH470, PH471 taken as a senior. Open to all science majors.

**PH448 Intern/Externship Program (1.0 Credits)**

Students have the opportunity to work in an industrial or research laboratory atmosphere under the direction of a selected scientist. Credit will be determined by the length of the experience. 1 to 4 credits.

**PH470 Research Project (1.0 Credits)**

Research project in physics with a physics faculty member. Research areas include x-ray diffraction, x-ray fluorescence spectrometry, optical properties of solids, holography and solid state (condensed matter) physics. One to four semesters, 1–4 credits per semester. Only 8 credits applied to the major. PH370, PH371 taken as a junior; PH470, PH471 taken as a senior. Open to all science majors.

**PH471 Research in Physics (1.0 Credits)**

Research project in physics with a physics faculty member. Research areas include x-ray diffraction, x-ray fluorescence spectrometry, optical properties of solids, holography and solid state (condensed matter) physics. One to four semesters, 1–4 credits per semester. Only 8 credits applied to the major. PH370, 371 taken as a junior; PH470,471 taken as a senior. Open to all science majors.

## Faculty

**Beth A. Schaefer, Professor of Physics; Chair, Department of Mathematics, Computer Science, and Physics; Coordinator of the Physics Program**

Ph.D., M.S., Boston College

B.A., Boston University

**Robert Devlin, Coordinator of the Math Lounge**

M.A.T., Monmouth University

B.S., Boston College

**Dae Wook Kim, Assistant Professor of Computer Information Sciences; Director, Computer Information Systems Program**

Ph.D., Wright State University

M.S., Syracuse University

B.S., Michigan State University

**Sarita Nemani, Professor of Mathematics**

Ph.D., University of New Brunswick, Canada

M.Phil., Indian Institute of Technology

M.S., B.S., University of Bombay

**Saroj Aryal, Associate Professor of Mathematics**

Ph.D., M.S., University of Wyoming

B.S., Trinity College (CT)

**Anne E. Tabor-Morris, Professor of Physics; Director of Georgian Court University NASA Science Outreach**

Ph.D., University of Notre Dame

B.S., Lehigh University