

MATHEMATICS, BACHELOR OF ARTS

Math Course Placement and Sequencing for All Homewood Students

There are three different versions of single variable calculus offered by the Mathematics Department, including 2 versions of semester courses in Calculus I and II, roughly equivalent to Calculus AB and BC in the College Board's Advanced Placement (AP) system, and a single semester honors version encompassing both Calculus I and II. Students should select their first course in mathematics at JHU based on their intended areas of study, prior experience and training in mathematics, and the results of an advisory Mathematics Placement Process, mandatory for incoming first-year students. Students intending to major in mathematics, the natural sciences, or engineering, or who are interested in studying mathematics beyond a year of single variable calculus are strongly encouraged to begin with the AS.110.108 Calculus I (Physical Sciences & Engineering) - AS.110.109 Calculus II (For Physical Sciences and Engineering) sequence or AS.110.113 Honors Single Variable Calculus. Students majoring in other subjects, or who do not intend to continue taking mathematics courses beyond a year of calculus, may wish to take the sequence AS.110.106 Calculus I (Biology and Social Sciences) - AS.110.107 Calculus II (For Biological and Social Science). This latter sequence relates the methods of calculus to the biological and social sciences. A one-semester precalculus course (AS.110.105 Precalculus) is offered for students who would benefit from practice modeling with tools used in calculus.

Entering students may receive course credit for Calculus I or Calculus I and II on the basis of the performance level on either the AP or International Baccalaureate (IB) exams (<https://e-catalogue.jhu.edu/arts-sciences/full-time-residential-programs/undergraduate-policies/academic-policies/external-credit/>). All students, regardless of completion of advanced placement exams previously, must engage with a Mathematics Placement Process to determine their appropriate first course in mathematics. Additional placement information can be found here (<http://mathematics.jhu.edu/undergraduate/placement-exams/>).

After completing a full year of calculus, the courses AS.110.201 Linear Algebra, AS.110.202 Calculus III, or AS.110.302 Differential Equations and Applications may be taken in any order. The department offers honors courses of the former 2; AS.110.212 Honors Linear Algebra and AS.110.211 Honors Multivariable Calculus.

Students entering the program with advanced training; for example, courses completed either within high school or at another university or college that are above single-variable calculus, may petition the department for a personal assessment of how well these courses compare to what is offered at Johns Hopkins. Should the courses compare well, the department may offer either a credit transfer or course waiver from having to take the comparable course(s) at Johns Hopkins. Contact the department's Director of Undergraduate Studies for more information.

Mathematics Major Requirements

(Also see Requirements for a Bachelor's Degree (<https://e-catalogue.jhu.edu/ksas-wse/undergraduate-policies/academic-policies/requirements-bachelors-degree/>)).

The undergraduate program in the Department of Mathematics is intended both for students interested in preparing for graduate study and research in pure mathematics, and for students interested in using mathematics to pose and solve problems in the sciences, engineering, social sciences, or other areas. Undergraduate mathematics majors will study:

- The foundations of analysis, which begins with the study of functions and their derivatives and integrals
- The fundamentals of advanced algebra, which is based on axiomatic systems involving operations of addition and multiplication in general settings
- Additional subjects such as geometry, probability, and topology
- Applications of mathematics to science and/or engineering.

Foundational Ability #1 (FA1) Writing and Communication in the Major - Students must complete at least 6 credits of Writing and Communication foundational ability coursework in one major. For this upcoming 2024-2025 academic year, candidates for the Bachelor of Arts degree in Mathematics will be able to fulfill this requirement by selecting 6 credits of electives or other courses in the major that are designated as Writing and Communications courses. The program includes numerous courses at all levels designated as FA1.

A candidate for the Bachelor of Arts degree in Mathematics is required to have completed the major requirements listed below. All courses used to meet these requirements must be completed with a grade of C- or better and may not be taken using the satisfactory/unsatisfactory (S/U) grading scheme.

Code	Title	Credits
AS.110.106 or AS.110.108	Calculus I (Biology and Social Sciences) Calculus I (Physical Sciences & Engineering)	4
AS.110.107 or AS.110.113 or AS.110.109	Calculus II (For Biological and Social Science) ¹ Honors Single Variable Calculus Calculus II (For Physical Sciences and Engineering)	4
AS.110.202 or AS.110.211	Calculus III ² Honors Multivariable Calculus	4
AS.110.201 or AS.110.212	Linear Algebra ² Honors Linear Algebra	4
AS.110.401 or AS.110.411	Introduction to Abstract Algebra Honors Algebra I	4
AS.110.304 or AS.110.412 or AS.110.413 or AS.110.422 or AS.110.435	Elementary Number Theory ^{2,3} Honors Algebra II Introduction To Topology Representation Theory Introduction to Algebraic Geometry	3-4
AS.110.405 or AS.110.415	Real Analysis I ² Honors Analysis I	4
AS.110.311 or AS.110.406 or AS.110.407 or AS.110.413 or AS.110.416 or AS.110.417 or AS.110.421 or AS.110.439	Methods of Complex Analysis Real Analysis II Honors Complex Analysis Introduction To Topology Honors Analysis II Partial Differential Equations Dynamical Systems Introduction To Differential Geometry	3-4

or AS.110.441	Calculus on Manifolds	
One 300-level or higher math course. Examples include: ⁴		3-4
AS.110.301	Introduction to Proofs	
AS.110.302	Differential Equations and Applications	
Two courses in any one of the approved applications of mathematics or other courses approved by the Director of Undergraduate Studies. ⁵		8
Total Credits		41-44

¹ Honors Single Variable is a single 4 credit course that will count toward the major or minor in mathematics as both Calculus I and Calculus II.

² Majors are encouraged but not required to take the honors variant.

³ AS.110.413 Introduction To Topology cannot be used for more than one requirement.

⁴ Math courses are defined as courses AS.110.xxx. Any course designated as AS.110.3XX or above can satisfy this requirement as long as the same course is not used for another requirement for the major defined above.

⁵ See table below for some examples of approved application courses. All other choices must be approved by the Director of Undergraduate Studies, and must be upper-level, quantitative in nature, and both from the same department or program.

Approved Courses in Areas of Application

Code	Title	Credits
Physics		
AS.171.204	Classical Mechanics II	4
AS.171.301	Electromagnetic Theory II	4
AS.171.303	Quantum Mechanics I	4
AS.171.304	Quantum Mechanics II	4
AS.171.312	Statistical Physics/Thermodynamics	4
Chemistry		
AS.030.302	Physical Chemistry II	3
AS.030.453	Intermediate Quantum Chemistry	3
Economics		
AS.180.301	Microeconomic Theory	4
AS.180.302	Macroeconomic Theory	4
AS.180.334	Econometrics	3
Computer Science		
EN.601.231	Automata & Computation Theory	3
EN.601.433	Intro Algorithms	3
EN.601.442	Modern Cryptography	3
EN.601.457	Computer Graphics	3
EN.601.461	Computer Vision	3
EN.601.464	Artificial Intelligence	3
EN.601.475	Machine Learning	3
Applied Mathematics and Statistics		
EN.553.361	Introduction to Optimization I	4
EN.553.362	Introduction to Optimization II	4
EN.553.391		4
EN.553.420	Probability	4
EN.553.426	Introduction to Stochastic Processes	4
EN.553.430	Mathematical Statistics	4
EN.553.453	Mathematical Game Theory	4

EN.553.465		4
EN.553.471	Combinatorial Analysis	4
EN.553.472	Graph Theory	4
EN.553.481	Numerical Analysis	4
EN.553.492	Mathematical Biology	3
EN.553.493	Mathematical Image Analysis	4
Philosophy		
AS.150.420	Mathematical Logic I	3
AS.150.421	Mathematical Logic II	3
AS.150.422	Axiomatic Set Theory	3

Sample Program of Study

The following chart is one example of how a student might progress through the mathematics major. As potential math majors enter JHU with a wide range of prior math abilities, students should begin courses at their current level of knowledge.

First Year

First Semester	Credits	Second Semester	Credits
AS.110.108	4	AS.110.109	4
	4		4

Second Year

First Semester	Credits	Second Semester	Credits
AS.110.202 or 211	4	AS.110.201 or 212	4
		AS.110.302 (or other 300+ level elective)	4
	4		8

Third Year

First Semester	Credits	Second Semester	Credits
AS.110.405 or 415	4	AS.110.406 or 416	4
Math application course	3-4		
	7-8		4

Fourth Year

First Semester	Credits	Second Semester	Credits
AS.110.401	4	AS.110.304	4
		Math application course	3-4
	4		7-8

Total Credits 42-44

Honors Program in Mathematics

As a general guideline, departmental honors are awarded to recipients of the B.A. degree who have completed the following with a combined GPA of at least 3.6 out of 4.0:

- both AS.110.411 Honors Algebra I and AS.110.412 Honors Algebra II,
- both AS.110.415 Honors Analysis I and AS.110.416 Honors Analysis II,
- either AS.110.407 Honors Complex Analysis or AS.110.607 Complex Variables,
- and one more course at the 400-level or above.

J.J. Sylvester Prize

The J.J. Sylvester Prize in Mathematics, which carries a cash award, is given each year to the one of two top-performing graduating seniors majoring in mathematics for outstanding achievement.

Undergraduate Teaching Assistantships

The department awards many upper-level undergraduates the opportunity to act as recitation instructors to our freshman courses. This award enables a student to practice the art of teaching and communicating mathematics in an environment where they are hired as a formal instructor to aid the professor of a regular curriculum course as a Teaching Assistant (TA). Undergraduate TAs are fully mentored and monitored, and the position provides a valuable credential and experience.

Undergraduate Learning Goals

At the time of graduation, math majors should:

- Have a good working knowledge of the language of mathematics as embodied in the basic constructs of mathematics in the fundamental areas of algebra, analysis, and geometry
- Be able to analyze the logical structure of a scientific or mathematical problem and to develop a meaningful approach to a solution
- Be able to read, understand, and construct a well-formed proof
- Develop the mathematical maturity and skills necessary to extend their knowledge through self-study and independent research
- Be able to apply mathematical methods to solve research problems arising outside of mathematics
- Be able to formulate precise mathematical statements and questions
- Be able to effectively and successfully communicate mathematics in both oral and written form to a broad mathematical and lay audience.