MATHEMATICS

The Mathematics curriculum is designed to expose students to a wide spectrum of ideas in modern mathematics, train students in the art of logical reasoning and clear expression, and provide students with an appreciation of the beauty of the subject and of its vast applicability.

Students may complete a major or minor in Mathematics. Within the major, students may complete the requirements for secondary school certification. In addition, there are various programs that, for suitably advanced students, can be combined with the major. These include the combined A.B./M.A. program at Bryn Mawr, and combined degree programs in engineering at the California Institute of Technology, Columbia University, and the University of Pennsylvania.

Advanced Placement

Students entering with a 4 or 5 on the Calculus AB advanced placement test will be given credit for MATH B101 and could enroll in MATH B102 or MATH B201 as their first mathematics course. Students entering with a 4 or 5 on the Calculus BC advanced placement test will be given credit for MATH B101 and MATH B102, and should enroll in MATH B201 as their first mathematics course. All other students are strongly encouraged to take the Mathematics Placement Exam so they can be best advised.

Major Requirements

The requirements in mathematics are designed to ensure that all students have a solid foundation in mathematical reasoning, both algebraic and analytic, as well as an appreciation for how mathematics can be used in applications. A common core of four key courses will lay the groundwork for additional exploration in the major. Students will achieve breadth in their program by exploring three main areas of mathematical thought: algebraic (AL), analytic (AN), and applied (AP). They will achieve depth in some areas of mathematical knowledge by taking a minimum of three courses at the 300-level. Students will better understand how technology can (and cannot) be used to further mathematical understanding with an introduction to computational methods as part of the Transitions course (MATH B206), and they will develop their abilities to learn independently and communicate clearly, both orally and in written form, through completion of the Senior Conference (MATH B399).

All math majors must complete a minimum of 10 courses at the 200 level or above, including:

- [Common Core]
  - MATH B201 Multivariable Calculus (or MATH H121 or MATH H216)
  - MATH B203 Linear Algebra (or MATH H215)
  - MATH B206 Transition to Higher Mathematics (WI). This course is a pre-requisite for all 300-level Bryn Mawr math courses.
  - MATH B301 Real Analysis I (or MATH H317) orMATH B303 Abstract Algebra I (or MATH H334)
- [Breadth] Among the common core, depth, and elective choices, courses must include at least one course with each of the algebraic (AL), analytic (AN), and applied (AP) designations found in lists below.
- [Depth] A minimum of three 300-level (or 500-level) math courses including MATH B301 and/or MATH B303 but not including senior conference (MATH B398/MATH B399) or senior research (MATH B400/MATH B403).
- [Senior Capstone] One semester of Senior Conference MATH B398/MATH B399.

These requirements will apply to students who start at Bryn Mawr in fall 2022 or later (i.e. Class of '26). Students who started in fall 2021 have the option of following these requirements or the previous requirements (see below). Students starting in fall 2020 or earlier are governed by the previous requirements. Students who are unsure about which set of requirements to follow should consult the department.

Mathematics majors are encouraged to complete their core requirements other than Senior Conference by the end of their junior year. Senior Conference must be taken during the senior year.

Students considering the possibility of graduate study in mathematics or related fields are urged to go well beyond the minimum requirements of the major. In such cases, a suitable program of study should be designed with the advice of a major advisor.

The following is a list of courses that satisfy the Algebraic (**AL**) Requirement:

- MATH B221 Introduction to Topology and Geometry
- MATH B290 Elementary Number Theory
- MATH B295 Select Topics in Mathematics: Combinatorics
- MATH B303 Abstract Algebra I/MATH H333
- MATH B304 Abstract Algebra II/MATH H334
- MATH B312/MATH B512/MATH H335: Topology
- MATH B317: Topics in Algebra
- MATH B390 Number Theory
- MATH H394: Advanced topics in Theoretical Computer Science and Discrete Math
- MATH B503 Graduate Algebra I
- MATH B504 Graduate Algebra II
- MATH B525 Algebraic Topology
- MATH H395: Advanced topics in Combinatorics.

The following is a list of courses satisfying the Analysis (**AN**) Requirement:

- MATH B205 Theory of Probability with Applications/MATH H218
- MATH B210 Differential Equations with Applications/MATH H204
- MATH B261: Introduction to Harmonic Analysis and Wavelets;
- MATH B301 Real Analysis I/MATH H317
- MATH B302 Real Analysis II/MATH H318
- MATH B310 Mathematics of Financial Derivatives
- MATH B311: Partial Differential Equations
- MATH B312 Topology/MATH B512/MATH H335
- MATH B322 Functions of Complex Variables/MATH B522
- MATH H340/CMSC H340: Analysis of Algorithms
- MATH H345/CMSC H345: Theory of Computation
- MATH B390 Number Theory
- MATH B501 Graduate Real Analysis I
- MATH B502 Graduate Real Analysis II
- MATH B530 Differential Topology
- MATH H328 Mathematical Statistics

- MATH H328: Mathematical Statistics
- MATH H337: Differential Geometry.

The following is a list of courses satisfying the Applied (**AP**) Requirement:

- CHEM B221 Physical Chemistry I or CHEM H305 Quantum Chemistry
- CHEM B321: Advanced Physical Chemistry
- CMSC B231 Discrete Mathematics
- CMSC B311 Computational Geometry
- ECON B304 Econometrics/ECON H304
- PHYS B205 Mathematical Methods in the Sciences I
- PHYS B207 Mathematical Methods in the Sciences II
- PHYS B328 Galactic Dynamics & Advanced Classical Mechanics
- MATH H203: Statistical Methods and their Applications
- MATH B205 Theory of Probability with Applications/MATH H218
- MATH B208 Introduction to Modeling and Simulation: Modeling & Simulation
- MATH B210 Differential Equations with Applications/H204: Differential Equations
- MATH H210: Linear Optimization
- MATH H222: Scientific Computing: Continuous Systems
- MATH B225 Introduction to Financial Mathematics
- MATH H286/STAT H286: Multivariate Statistical Analysis
- MATH H286/STAT H286: Advanced Topics in Statistics
- MATH H328/STAT H328: Mathematical Statistics
- MATH B295 Select Topics in Mathematics: Actuarial Mathematics
- MATH B295 Select Topics in Mathematics: Math Modeling & Sustainability
- MATH B295 Select Topics in Mathematics: Combinatorics
- MATH B295 Select Topics in Mathematics: Statistics with R
- MATH B295 Select Topics in Mathematics: Statistical Methods and their Applications
- MATH B308 Applied Mathematics I
- MATH B310 Mathematics of Financial Derivatives: Math of Financial Derivatives
- MATH B325 Advanced Topics in Applied Mathematics: Evolutionary Dynamics
- MATH B325 Advanced Topics in Applied Mathematics: Optimal Control in Biological Models
- MATH B325 Advanced Topics in Applied Mathematics: Numerical Linear Algebra
- MATH H360: Mathematical Economics
- MATH H397: Advanced Topics in Applied Math: Mathematical Modeling

When a course is listed in more than one breadth category, a student may choose in which category to count it. But a course may only be counted once for breadth. This list is not exhaustive. For the status of courses not on the list, students should consult the department.

For students declaring the math major in 2024-25 (or later), at most two courses can be doubled counted for a second major. For students who have declared the math major in 2023-24 or earlier, at most three courses can be doubled counted for a second major.

Major Writing Requirement

Students will take MATH B206 Transition to Higher Mathematics,a writing intensive course, to satisfy the major writing requirement. Students will learn mathematical writing in the form of both proof and computer coding. This course will prepare students for the mathematical writing they will be doing at the 300 level.

Honors

The degree with honors will be awarded by the Department to students who complete the major in mathematics and satisfy the following two additional requirements.

1. Complete a thesis project.
   a. The thesis consists of a written project, which can be expository or contain original results, and an oral presentation of the thesis. The thesis typically involves two semesters worth of work.
   b. While doing their two semesters of thesis work, students will be enrolled in a research course (typically Math B400: Senior Research). These two semesters of research work do not count as electives towards fulfilling the major requirements.
2. Display a high level of commitment to mathematics, which can be demonstrated in multiple ways, for example:
   a. Strong academic achievement demonstrated by a grade point average of at least 3.6 calculated using top grades from 10 math courses that complete the math major, or
   b. Successfully completing with a merit grade at least two additional mathematics courses beyond the requirements of the major and thesis, or
   c. Engagement with mathematical activities outside of formal course work. This could include completing a summer research project or internship, strong dedication to TAing or tutoring in math, or leadership or persistent engagement in activities that contribute to supporting and strengthening our mathematical community (such as DMC, Problem Solving Seminar, SMARP Group, or serving as a Major Representative).

Students may, in consultation with their thesis advisor, petition the Department to adjust these requirements in unusual circumstances.

Previous Major Requirements

Details of the previous mathematics major requirements can be found in the College's Catalog Archives.

Students who started at Bryn Mawr in Fall 2020 or earlier are governed by these previous requirements. Students who started in Fall 2021 have the option of following the previous requirements or the newer requirements outlined above. Students who are unsure about which set of requirements to follow should consult the Department.

Minor Requirements

The math minor requires five courses in mathematics at Bryn Mawr or Haverford.

Two of the mathematics courses must be at the 300-level or higher and the remaining three courses must be at least at the 200-level or higher; the Haverford course, Math H121, Multivariable Calculus, can also be counted towards the math minor as if it were a 200-level course. Note that MATH B206: Transitions to Higher Mathematics is a pre-requisite for any 300-level math course at Bryn Mawr.

Any of the courses from other departments listed below in the Math Electives section can be counted as a mathematics course towards the minor. These courses may only be counted as 200-level courses for the purposes of the math minor, regardless of their course numbers within their own departments. At most one course may double-count towards both your major and the math minor.

It may also be possible to count certain math courses taken at other colleges and universities towards the math minor. This will always require special permission from the Mathematics Department.

MATH B101 Calculus I (1 Unit)
This is the first in a sequence of two courses that covers single-variable calculus. Topics include functions, limits, continuity, derivatives, differentiation formulas, applications of derivatives, integrals, and the fundamental theorem of calculus. Prerequisite: proficiency in high-school mathematics (including algebra, geometry, and trigonometry).

MATH B101L Calculus I lab (0.5 Unit)
This lab course will reinforce the concepts and skills that are needed to be successful in Calculus 1. Students must be enrolled in MATH B101 Calculus I to enroll in this course.

MATH B102 Calculus II (1 Unit)
This is the second in a sequence of two courses that covers single-variable calculus. Topics include techniques of integration, applications of integration, infinite sequences and series, tests of convergence for series, and power series. Prerequisite: a merit grade in Math 101 (or an equivalent experience).

MATH B104 Basic Probability and Statistics (1 Unit)
This course introduces key concepts in descriptive and inferential statistics. Topics include summary statistics, graphical displays, correlation, regression, probability, the Law of Large Numbers, expected value, standard error, the Central Limit Theorem, hypothesis testing, sampling procedures, bias, and the use of statistical software.

MATH B195 Select Topics in Mathematics (1 Unit)
This is a topics course. Course content varies.

MATH B201 Multivariable Calculus (1 Unit)
This course extends calculus to functions of multiple variables. Topics include functions, limits, continuity, vectors, directional derivatives, optimization problems, multiple integrals, parametric curves, vector fields, line integrals, surface integrals, and the theorems of Gauss, Green and Stokes. Prerequisite: a merit grade in Math 102 (or an equivalent experience).

MATH B203 Linear Algebra (1 Unit)
This course considers systems of linear equations, matrix algebra, determinants, vector spaces, subspaces, linear independence, bases, dimension, linear transformations, eigenvalues, eigenvectors, orthogonality, and applications of linear algebra. Prerequisite (or corequisite): Math 102.

MATH B205 Theory of Probability with Applications (1 Unit)
The course analyzes repeatable experiments in which short-term outcomes are uncertain, but long-run behavior is predictable. Topics include: random variables, discrete distributions, continuous densities, conditional probability, expected value, variance, the Law of Large Numbers, and the Central Limit Theorem. Prerequisite: Math 201.

MATH B206 Transition to Higher Mathematics (1 Unit)
This course focuses on mathematical writing and proof techniques. Topics include symbolic logic, set notation and quantifiers, proof by contradiction and induction, set notation and operations, relations and partitions, functions, and more. Prerequisite or Co-requisite: MATH B201 or MATH B203. Not open to students who have taken a 300 level Math course

MATH B208 Introduction to Modeling and Simulation (1 Unit)
Mathematical models are constructed to describe the complex world within and around us. Computational methods are employed to visualize and solve these models. In this course, we focus on developing mathematical models to describe real-world phenomena, while using computer simulations to examine prescribed and/or random behavior of various systems. The course includes an introduction to programming (in R or Matlab/Octave), and mathematical topics may include discrete dynamical systems, model fitting using least squares, elementary stochastic processes, and linear models (regression, optimization, linear programming). Applications to economics, biology, chemistry, and physics will be explored. Prior programming experience not required. Prerequisite: MATH B102 or the equivalent (merit score on the AP Calculus BC Exam or placement).

MATH B210 Differential Equations with Applications (1 Unit)
Ordinary differential equations, including general first-order equations, linear equations of higher order and systems of equations, via numerical, geometrical, and analytic methods. Applications to physics, biology, and economics. Co-requisite: MATH 201 or 203.

MATH B221 Introduction to Topology and Geometry (1 Unit)
An introduction to the ideas of topology and geometry through the study of knots and surfaces in three-dimensional space. The course content may vary from year to year, but will generally include some historical perspectives and some discussion of connections with the natural and life sciences. Co-requisite: MATH 201 or 203.

MATH B225 Introduction to Financial Mathematics (1 Unit)
Topics to be covered include market conventions and instruments, Black-Scholes option-pricing model, and practical aspects of trading and hedging. All necessary definitions from probability theory (random variables, normal and lognormal distribution, etc.) will be explained. Prerequisite: MATH 102. ECON 105 is recommended.

MATH B290 Elementary Number Theory (1 Unit)
Properties of the integers, divisibility, primality and factorization, congruences, Chinese remainder theorem, multiplicative functions, quadratic residues and quadratic reciprocity, continued fractions, and applications to computer science and cryptography. Prerequisite: MATH 102.

MATH B295 Select Topics in Mathematics (1 Unit)
This is a topics course. Course content varies. Not all topics are open to first year students.

MATH B301 Real Analysis I (1 Unit)
A first course in real analysis, providing a rigorous development of single variable calculus, with a strong focus on proof writing. Topics covered: the real number system, elements of set theory and topology, limits, continuous functions, the intermediate and extreme value theorems, differentiable functions and the mean value theorem, uniform continuity, the Riemann integral, the fundamental theorem of calculus. Possible additional topics include analysis on metric spaces or dynamical systems. Prerequisite: MATH 201 and MATH B206 or permission of instructor.

MATH B302 Real Analysis II (1 Unit)
A continuation of Real Analysis I: Infinite series, power series, sequences and series of functions, pointwise and uniform convergence, and additional topics selected from: Fourier series, calculus of variations, the Lebesgue integral, dynamical systems, and calculus in higher dimensions. Prerequisite: MATH 301.

MATH B303 Abstract Algebra I (1 Unit)
A first course in abstract algebra, including an introduction to groups, rings and fields, and their homomorphisms. Topics covered: cyclic and dihedral groups, the symmetric and alternating groups, direct products and finitely generated abelian groups, cosets, Lagrange's Theorem, normal subgroups and quotient groups, isomorphism theorems, integral domains, polynomial rings, ideals, quotient rings, prime and maximal ideals. Possible additional topics include group actions and the Sylow Theorems, free abelian groups, free groups, PIDs and UFDs. Prerequisite: MATH 203 and MATH B206 or permission from instructor.

MATH B304 Abstract Algebra II (1 Unit)
A continuation of Abstract Algebra I. Vector spaces and linear algebra, field extensions, algebraic and transcendental extensions, finite fields, fields of fractions, field automorphisms, the isomorphism extension theorem, splitting fields, separable and inseparable extensions, algebraic closures, and Galois theory. Also, if not covered in Abstract Algebra I: group actions and Sylow theorems, free abelian groups, free groups, PIDs and UFDs. Possible additional topic: finitely generated modules over a PID and canonical forms of matrices. Prerequisite: MATH 303.

MATH B308 Applied Mathematics I (1 Unit)
This course will provide a general introduction to methods and modeling in applied mathematics. A variety of mathematical tools will be used to develop and study a wide range of models, including deterministic, discrete, and stochastic methods. Additional emphasis will be placed on techniques for analyzing mathematical models, including phase plane methods, stability analysis, dimensional analysis, bifurcation theory, and computer simulations. Applications to biology, physics, chemistry, engineering, and the social sciences may be discussed. Prerequisite: MATH B203 and MATH B206 and MATH B210 or permission of instructor.

MATH B310 Mathematics of Financial Derivatives (1 Unit)
An introduction to the mathematics utilized in the pricing models of derivative instruments. Topics to be covered may include Arbitrage Theorem, pricing derivatives, Wiener and Poisson processes, martingales and martingale representations, Ito's Lemma, Black-Scholes partial differentiation equation, Girsanov Theorem and Feynman-Kac Formula. Prerequisite: MATH 201 and MATH B206 or permission of instructor.

MATH B312 Topology (1 Unit)
General topology (topological spaces, continuity, compactness, connectedness, quotient spaces), the fundamental group and covering spaces, introduction to geometric topology (classification of surfaces, manifolds). Typically offered yearly in alternation with Haverford. Co-requisite: MATH 301, MATH 303, or permission of instructor.

MATH B322 Functions of Complex Variables (1 Unit)
Analytic functions, Cauchy's theorem, Laurent series, calculus of residues, conformal mappings, Moebius transformations. Prerequisite: MATH 301 or permission of instructor.

MATH B325 Advanced Topics in Applied Mathematics (1 Unit)
This topics course will focus on one advanced area in applied mathematics. Topics may include numerical linear algebra, applied partial differential equations, optimal control, parameter estimation and model fitting. Prerequisite: Math B203 or Math B210 and Math 206 or Math B301, or permission of instructor

MATH B390 Number Theory (1 Unit)
Study of integers with an emphasis on their multiplicative structure and topics related to analysis, and a first course in analytic number theory. Core topics: divisibility and primes, arithmetic functions, average and extremal orders, techniques of analytic number theory, Riemann zeta function, prime number theorem, Dirichlet characters, L-functions. Possible additional topics may include approximations by rational numbers, geometry of numbers, algebraic numbers and class numbers, sums of squares, and the idea of modular forms. Prerequisite: Math 201 and MATH B206, or permission of instructor.

MATH B398 Senior Conference (1 Unit)
A seminar for seniors majoring in mathematics. Topics vary from year to year.

MATH B399 Senior Conference (1 Unit)
A seminar for seniors majoring in mathematics. Topics vary from year to year.

MATH B400 Senior Thesis (1 Unit)
Independent research for senior thesis in Math

MATH B403 Supervised Work (1 Unit)

MATH B501 Graduate Real Analysis I (1 Unit)
In this course we will study the theory of measure and integration. Topics will include Lebesgue measure, measurable functions, the Lebesgue integral, the Riemann-Stieltjes integral, complex measures, differentiation of measures, product measures, and L^p spaces.

MATH B502 Graduate Real Analysis II (1 Unit)
This course is a continuation of Math 501.

MATH B503 Graduate Algebra I (1 Unit)
This is the first course in a two course sequence providing a standard introduction to algebra at the graduate level. Topics in the first semester will include categories, groups, rings, modules, and linear algebra.

MATH B504 Graduate Algebra II (1 Unit)
This course is a continuation of Math 503, the two courses providing a standard introduction to algebra at the graduate level. Topics in the second semester will include linear algebra, fields, Galois theory, and advanced group theory. Prerequisite: MATH B503.

MATH B511 Graduate Complex Analysis I (1 Unit)

MATH B512 General Topology (1 Unit)
This course covers the basic notions of point set topology, with an introduction to algebraic and geometric topology. Topics covered include topological spaces, continuity, compactness, connectedness, quotient spaces, the fundamental group and covering spaces, and the classification of surfaces.

MATH B517 Adv Topics in Mathematics (1 Unit)

MATH B522 Complex Analysis (1 Unit)
This course covers the basic notions of complex analysis. Topics covered include analytic functions, Cauchy's theorem, the calculus of residues, conformal mappings, Riemann mapping theorem and Picard's little theorem.

MATH B525 Algebraic Topology (1 Unit)
This course covers the basic notions of algebraic topology. Topics covered include homology theory, cohomology theory, duality on manifolds, and an introduction to homotopy theory.

MATH B530 Differential Topology (1 Unit)
This course covers the basic notions of differential topology. Topics covered include smooth manifolds, smooth maps, differential forms, and integration on manifolds.

MATH B670 Graduate Perspectives in Mathematics Pedagogy (1 Unit)
This course will cover a spectrum of topics in mathematics pedagogy of importance for graduate students serving as mathematics teaching assistants as well as those preparing to teach high school, community college, or university-level mathematics. It will meet every other week for three hours following a seminar format combining some lectures and guest speakers with extended discussion.

MATH B800 Continuing Enrollment (0 Unit)

CHEM B221 Physical Chemistry I (1 Unit)
Introduction to quantum theory and spectroscopy. Atomic and molecular structure; molecular modeling; rotational, vibrational, electronic and magnetic resonance spectroscopy. Lecture three hours. Prerequisites: CHEM B104 and MATH B201.

CMSC B231 Discrete Mathematics (1 Unit)
An introduction to discrete mathematics with strong applications to computer science. Topics include propositional logic, proof techniques, recursion, set theory, counting, probability theory and graph theory. Prerequisites: CMSC B113 or B109 or H105 or H107

CMSC B311 Computational Geometry (1 Unit)
A study of algorithms and mathematical theories that focus on solving geometric problems in computing, which arise naturally from a variety of disciplines such as Computer Graphics, Computer Aided Geometric Design, Computer Vision, Robotics and Visualization. The materials covered sit at the intersection of pure Mathematics and application-driven Computer Science and efforts will be made to accommodate Math majors and Computer Science majors of varying math/computational backgrounds. Topics include: graph theory, triangulation, convex hulls, geometric structures such as Voronoi diagrams and Delaunay triangulations, as well as curves and polyhedra surface topology. Prerequisite: CMSC B151 or CMSC H106 or CMSC H107, and CMSC B231, or CMSC H231 or MATH B231 or MATH H231, or permission of instructor.

CMSC B340 Analysis of Algorithms (1 Unit)
This course will cover qualitative and quantitative analysis of algorithms and their corresponding data structures from a precise mathematical point of view. Topics include: performance bounds, asymptotic and probabilistic analysis, worst case and average case behavior and correctness and complexity. Particular classes of algorithms will be studied in detail. This course fulfills the writing requirement in the major. Prerequisites: CMSC B151, or CMSC H106 or CMSC H107, and CMSC B231, or CMSC H231 or MATH B231 or MATH H231 or permission of instructor.

ECON B304 Econometrics (1 Unit)
The econometric theory presented in ECON 253 is further developed and its most important empirical applications are considered. Each student does an empirical research project using multiple regression and other statistical techniques. Prerequisites:ECON B253 or ECON H203 or ECON H204 and ECON B200 or ECON B202 and MATH B201 or permission of instructor.

PHYS B205 Mathematical Methods in the Sciences I (0.5 Unit)
This course is the first of two half-semester sessions which presents topics in applied mathematics useful to students in physics, engineering, physical chemistry, geology, and computer science. This first session will cover infinite series, complex variables, Fourier series, integral transforms, special functions, and ordinary differential equations. Lecture three hours and additional recitation sessions as needed. Prerequisite: MATH B102.

PHYS B207 Mathematical Methods in the Sciences II (0.5 Unit)
This course is the second of two half-semester sessions which presents topics in applied mathematics useful to students in physics, engineering, physical chemistry, geology, and computer science. This second session covers advanced ordinary differential equations, partial differential equations, special functions, series solutions, and boundary-value problems. Lecture three hours and additional recitation sessions as needed. Prerequisite: PHYS B205, MATH B201 and MATH B203

PHYS B306 Mathematical Methods in the Physical Sciences (1 Unit)
This course presents topics in applied mathematics useful to students, including physicists, engineers, physical chemists, geologists, and computer scientists studying the natural sciences. Topics are taken from Fourier series, integral transforms, advanced ordinary and partial differential equations, special functions, boundary-value problems, functions of complex variables, and numerical methods. Corequisites: (PHYS B201 or H106) and MATH B201. Lecture three hours and additional recitation sessions as needed.

PHYS B328 Galactic Dynamics & Advanced Classical Mechanics (1 Unit)
This course is for the advanced undergraduate interested in the physics galactic dynamics and evolution, i.e. collisionless, gravitational N-body systems composed of stars and dark matter. Topics covered will include potential theory, orbit theory, collisionless Boltzmann equation, Jeans equations, disk stability, violent relaxation, phase mixing, dynamical friction and kinetic theory. To support the these theories, we will also cover advanced topics in classical mechanics including Lagrange & Hamilton methods, the central force problem, canonical transformations, action-angle variables, chaos and perturbation theory. This course is taught in a seminar format, in which students are responsible for presenting much of the course material in class meetings. Prerequisites: MATH B201, MATH B203, PHYS B201, B214, and PHYS B308 or permission from instructor.