MATHEMATICS

The following courses present a sequential program by which students can gain an understanding of the style and content of mathematics, become adept in its fundamental skills, and explore the subject for the beauty of its abstractions and the variety of its applications. Aware of the increasing use of mathematics in both new and traditional fields, the department encourages students to continue their mathematical electives beyond the required courses in Algebra I, Algebra II, and Geometry.

For information on courses designated *GESC*, please refer to pages 5–6.

Please note: All courses require a TI-83 or TI-84 graphing calculator. Any version of these calculators is acceptable; the TI-85 and TI-81 are not. Students who do not currently own one of these calculators should buy the TI-84.

Algebra I
This course is for freshmen who have had less than a full year of algebra. It covers properties of the real number system, linear and quadratic equations, and properties of exponents and radicals. Throughout the course there is a strong emphasis on word problems and non-traditional problem solving. Students develop competence with the graphs of linear, quadratic, and exponential equations, and master a number of techniques for solving equations and simplifying algebraic expressions. While the course emphasizes the development of algebraic skills, it also introduces students to some of the numerical and graphical solutions to problems made possible with the TI-84 calculators.

Geometry
This standard mathematics course deals with Euclidean geometry of two and three dimensions. Construction with straight-edge and compass and an introduction to right-triangle trigonometry are included. When appropriate, students utilize technology (Geometer's Sketchpad) to enhance the learning process. The course's emphasis on rigorous deductive reasoning develops the skills needed to communicate more complex ideas effectively. Prerequisite: Algebra I

Advanced Geometry
This course is for able students who have had two full years of algebra. It covers the same topics as Geometry but at a faster pace and in greater depth. It also includes a more thorough study of trigonometry and coordinate geometry. Prerequisite: Algebra II and permission of the department

Algebra II
This course reviews and further develops the concepts of linear and quadratic equations and inequalities. It then explores functions involving radical expressions and rational polynomials and finally considers logarithmic and exponential functions and their applications. Beyond traditional algebraic techniques, students learn numerical and graphical solution techniques with the guided use of the TI-84 graphing calculators. Additional topics such as trigonometry, complex numbers, and sequences and series may be introduced along the way. Prerequisite: Algebra I

Advanced Algebra II
This course is for interested and able students who have done well in a full-year, in-depth, first-year algebra course. It covers at a faster pace and in more detail the same material as Algebra II, as well as conic sections, rational functions, and trigonometry. The TI-84 graphing calculator is used extensively in class. Placement for new students will be determined by the department. Prerequisite: Algebra I and permission of the department

Precalculus
The Precalculus course is intended for students who have completed both Algebra II and Geometry and who aspire to take Calculus or one of the statistics offerings in the following year. Students study the properties, graphs, and applications of a variety of different families of functions including linear, quadratic, polynomial, exponential, logarithmic, and trigonometric functions. These functions are explored graphically, algebraically, and numerically. The analysis of the functions is aided by the guided use of technology. While students have exposure to all the classic functions of high school math, the course is not intended for those who wish to move into the CL Calculus program. The course includes nearly eight weeks of work in discrete math topics: sequences, series, combinatorics, and introductions to probability and statistics.

Advanced Precalculus
This course is for students who have a strong background in Algebra and Geometry and who plan on taking the CL Calculus AB course or possibly CL Statistics. Students study the properties, graphs, and applications of a variety of

different families of functions including linear, quadratic, polynomial, rational, exponential, logarithmic, and trigonometric functions and also study sequences and series in considerable detail. The various functions as well as the work with sequences and series are explored algebraically, graphically, and numerically and are aided by the guided use of technology. In Advanced Precalculus there is less emphasis on the discrete topics of probability and statistics than in the regular Precalculus course; however, the trigonometric functions and their inverses as well as the notion of limit are covered in much more depth and detail since these topics are critical for success in the CL Calculus program.

Advanced Precalculus with Differential Calculus
This course is for students who have an exceptional background in Algebra and Geometry and who plan on taking the CL Calculus BC course. The course moves at an accelerated pace and thoroughly covers all the concepts of the Advanced Precalculus class during the fall and winter trimesters. The spring trimester is devoted to a rigorous introduction to differential calculus — a prerequisite for entry into the CL Calculus BC course. Some students may opt to study CL Statistics in addition to, or instead of, CL Calculus after this course.

Topics in Discrete Mathematics
fall term
This course explores a number of real-life mathematical applications and the theory behind them. Topics include Voting/Election Theory, the mathematics of power (The Benzhaf and Shapley-Shubik Power Indices), the mathematics of fair division, and the mathematics of apportionment pertaining to government bodies. The course is designed for both those who intend to take statistics in the winter and spring terms and those who have an interest in an elective mathematics course strongly based in theory and in different real-world applications. Prerequisite: Algebra II

Statistics I *(GESC) (winter)***; Statistics II** *(GESC) (spring)*
two-term course/winter only or winter and spring
This course offers a less in-depth approach to the material presented in CL Statistics. The course emphasizes problem-solving, student-generated studies, and group work. Students analyze a significant global issue while completing culminating projects in which they utilize the techniques learned throughout the course. These projects will have components of both written and public presentation. Throughout the course, students are introduced to the TI-84 graphing calculator, spreadsheet software like MS Excel, and web-based data analysis packages like Gapminder. *Students may elect either the first term or both terms of the course*. Prerequisite: Algebra II

CL Statistics
Equivalent to a one-semester, introductory, non-calculus-based college statistics course, this course incorporates four themes: exploring data, learning designs for data collection and experiments, anticipating patterns in advance, and drawing conclusions from data. Computers and the TI-84 calculator are important tools for completing data analysis and understanding more sophisticated statistical concepts. This data-based approach involves group activities and student-generated studies. The course emphasizes reading and communicating statistical information accurately in real-world situations. Prerequisite: Advanced Precalculus with Differential Calculus or Advanced Precalculus and permission of the department

Calculus
This course introduces students to most of the theories, techniques, and applications of a first-year calculus course. By mixing theory and application and by using both discrete and continuous examples, the course offers students a solid foundation of the basic techniques of differential and integral calculus and explores the utility of calculus in a variety of fields. Although not covering trigonometric functions, among other topics in the AP program, this course prepares students for a rigorous first-year calculus course in college and enables them to use calculus concepts in other disciplines. Prerequisite: Precalculus

CL Calculus AB
Following the Advanced Placement AB Calculus syllabus, this course introduces differential and integral calculus. Rules of differentiation for most of the common algebraic and transcendental functions are introduced, and students learn applications of the derivative in graph theory, motion problems, related rates of change, and optimization problems. The course introduces definite and indefinite integrals along with the most common techniques of integration and applications to area, volume, motion, and growth and decay. The calculus topics are explored algebraically, numerically, verbally, and graphically with the aid of the TI-84 calculator. Prerequisite: Advanced Precalculus or Advanced Precalculus with Differential Calculus

CL Calculus BC
Following the Advanced Placement BC Calculus syllabus, this course offers a rigorous, college-level introduction to differential and integral calculus. Topics include the theory and applications of derivatives and integrals of common algebraic and transcendental functions offered in Calculus AB. Beyond the topics from **CL Calculus AB**, students work

with the calculus concepts as they apply to vector functions, parametrically defined functions and polar functions, and also do significant work with sequences and series. The calculus topics are explored algebraically, numerically, verbally, and graphically with the aid of the TI-84 calculator. Prerequisite: Advanced Precalculus with Differential Calculus and permission of the department

CL Calculus — Topic C
half course
Following the Advanced Placement BC Calculus syllabus, this course offers a rigorous, college-level approach for completion to differential and integral calculus **beyond** the CL Calculus AB course. These topics include work with vector and parametrically defined functions, polar functions and relations, additional integral techniques, improper integrals and finally, significant work with sequences and series including Taylor polynomials and the Lagrange error estimates. In addition to work with these new topics, the course will review and consolidate the students' earlier work with differential and integral calculus studied in the CL Calculus AB course. The course prepares students for the AP BC exam. All topics are explored algebraically, numerically, verbally, and graphically with the aid of the TI-84 and other software platforms. Prerequisite: B+ or higher in CL Calculus AB and permission of the department

CL Statistics Accelerated
half course
This course is intended for extremely able math students who have excelled in a CL Calculus class. The class moves quickly covering the full Advanced Placement Statistics curriculum (see course description for CL Statistics) while meeting half as often as full courses. Unlike CL Statistics, this accelerated course will also include some work with statistics that is calculus based. While the course develops the tools necessary to analyze data and make projections in a variety of real-world situations, students should also come to appreciate the logical principles underlying the inferences. Students will use some of the powerful statistical tools of the TI-84 calculator to organize data and help make appropriate inferences. Prerequisite: A- or higher in BC Calculus or A or higher in AB Calculus and departmental approval

CL Multivariable Calculus
For students who have successfully completed CL Calculus BC, this course extends definitions, concepts, and algorithms of differential and integral calculus to higher-dimensional functions. The concepts of continuity, differentiability, local extrema, integration, volume, and the fundamental theorem of calculus are developed rigorously in the context of functions with multiple input and/or output variables. Application to physics, computer science and statistics, including relatively recent developments, will be discussed. The course emphasizes deep conceptual understanding of abstract content, since visualization is not always possible. In order to define the derivative in greatest generality as a linear function, we also borrow techniques from linear algebra, although not with the same degree or rigor or depth as in CL Linear Algebra. Prerequisite: permission of the department

CL Linear Algebra
Linear Algebra is for students who have shown exceptional promise in their study of mathematics. At the beginning of the year, linear algebra is introduced in terms of its main objects, vector spaces, and the relations between those objects, linear transformations. By approaching the subject this way, the class serves as an introduction to conceptual mathematical systems that will later create the foundation of abstract algebra. Throughout the course, emphasis is placed on learning the structure of formal mathematical proof writing. Topics that are typically covered in addition to vector spaces and linear transformations are matrix algebra, set theory, inner product spaces, eigenvectors, and determinants. Prerequisite/Co-requisite: Multivariable Calculus and permission of the department

Independent Studies in Mathematics
term course
A student who has exhausted the offerings of the Mathematics Department or who desires to study a math-related topic not offered as a course may propose an Independent Study Project for credit. The student must arrange for a project advisor from within the department, **submit a written proposal**, and obtain approvals from the academic advisor, project advisor, department head, and dean of faculty.

Introduction to Computer Science
fall term
This course offers a language-independent approach to learning the underlying principles of computing. Students will be exposed to a survey of ideas in computer science, centered around solving real-world problems. Topics include computer architecture, data storage and processing, networking, security, and information retrieval. This is primarily a concepts course, so programming will be minimal. Students will emerge with a diverse understanding of how computers influence the structure of the modern world. This course prepares students to take CL Computer Science.

CL Computer Science
two-term course/winter and spring
This course is a programming-intensive follow-up to Introduction to Computer Science. Students will spend most of the winter term learning how to code in Java, establishing a solid foundation in key techniques such as iteration and data management, as well as some common higher-order programming paradigms. Along the way, students will delve deeper into the theory behind computer architecture to bolster their understanding of algorithms and data structures. By the spring term, the course will circle back, and students will learn how to implement some of the tools covered during the fall term. This course is not focused on preparing students for either AP Computer Science exam. Prerequisite: Introduction to Computer Science or permission of department.

Topics in Logic
term course/juniors and seniors
Please see description under Philosophy, Psychology and Religion offerings. Students interested in logical foundations of mathematics and in greater sophistication in methods of proof may consider this course. Prerequisite: Geometry