Mathematics (MAT)

Major and Minor in Mathematics

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Minors of particular interest to students majoring in Mathematics: Applied Mathematics and Statistics (AMS), Computer Science (CSE), Economics (ECO), Physics (PHY)

Mathematics (MAT)

Mathematics is an essential element in a wide range of human activities. It is the language of the physical sciences, and as such is an indispensable tool in the formulation of the laws of nature. In the social and biological sciences, it plays an increasingly important role in modeling complicated, large-scale phenomena. In addition, mathematics has an aesthetic side: awareness of the possibility of elegance and beauty in mathematical arguments has been a significant feature of human culture throughout history. Today more mathematics is being done, and more needs to be done, than ever before.

The undergraduate course offerings in Mathematics allow students to set up individualized programs of study consistent with their academic interests and career plans. Students should consider majoring in Mathematics even if they do not plan to become mathematicians or teachers of mathematics. The training in abstract reasoning and problem-solving is an excellent foundation for many different careers, such as law, graduate health professions, and business. Completion of a major in Mathematics points to a thinking person.

Students are encouraged to explore the various branches of pure and applied mathematics, as well as other mathematically oriented disciplines, to gain both breadth of knowledge and insight into career options. Mathematics majors can use their training as the foundation for advanced professional study, leading to research and teaching in universities or research in industrial research laboratories; they can use it also in secondary school teaching. In industry, undergraduate training in mathematics is excellent preparation for the important task of liaison work between the technological arm of a company and its marketing arm. A major in Mathematics is particularly appropriate for work in computer applications, operations research, and actuarial science. Double majors in Mathematics and another field, such as physics, computer science, applied mathematics and statistics, or economics, are common and are encouraged.

The Mathematics Majors Program, which leads to the B.S. Degree in Mathematics, has two special options: Advanced Track option and Secondary Teacher Education option.

The advanced track option is designed for students open to the challenges of advanced mathematics. State-of-the-art courses are taught in small classes by leading faculty and cover a broad range of material. The advanced track students are encouraged to take advantage of our top-ranked graduate program; qualified students are welcome to take graduate courses. All in all, the advanced track will prepare a student well for the challenge of a graduate or professional school at the finest universities in the country or a career in a variety of fields.

The secondary teacher education option is designed for students planning a career teaching mathematics in a secondary school. This option is described in detail in the "Education and Teacher Certification" entry in the alphabetical listings of Approved Majors, Minors, and Programs.

The Department of Mathematics offers tutorial help to all undergraduate students in its 100-level courses in the Mathematics Learning Center. Since the Center's staff consists of faculty and graduate students in mathematics as well as undergraduate tutors, students in more advanced courses can also find assistance there.

The Department encourages students to seek information and advice on appropriate mathematics courses, programs, and career goals. Professors in mathematics are available as advisors in the Undergraduate Mathematics Office to help with these matters. Advising hours can be obtained by calling the Department of Mathematics.

Requirements for the Major and Minor in Mathematics (MAT)

Requirements for the
Major in Mathematics (MAT)

The major in Mathematics leads to the Bachelor of Science degree.

Completion of the major typically requires approximately 40 credits, depending on student preparation and choices made.

A. Mathematics and Mathematics-Related Courses

1. Single-variable Calculus: Either MAT 131 and MAT 132, or MAT 125 and MAT 126 and MAT 127, or AMS 151 and AMS 161, or MAT 141 and MAT 142, or MAT 171. Some or all of this requirement may be fulfilled by an appropriate score on the Mathematics Placement Exam, by AP credit, or by comparable means. If students do not place into MAT 125 or 131 on the basis of the math placement examination, MAT 123 is a required course for the major. Students of the Advanced Track fulfill this requirement with MAT 141 and MAT 142. These two courses will also fulfill Requirement 6 partly because they include the contents of MAT 319 or MAT 320.

2. Multivariable Calculus, Linear Algebra, and Differential Equations: One course in multivariable calculus (MAT 203 or MAT 307 or AMS 261), one course in introductory linear algebra (MAT 211 or AMS 210), and one course in differential equations (MAT 303 or MAT 308 or AMS 361). Students who take *both* MAT 307 and MAT 308 do not need to take a separate course in linear algebra, since this material is included in those courses. Students of the Advanced Track fulfill this requirement by taking MAT 220 and MAT 322.

3. Preparation in the language and logic of mathematics: this requirement can be met by either passing MAT 200 or by passing the MAT 200 challenge examination. (Note: the writing intensive course MAT 200 is a requirement for students in the Secondary Teacher Education Program.) Students of the Advanced Track fulfill this requirement by taking MAT 150.

4. One course in computer literacy: MAT 331 or PHY 277 or CSE 110 or CSE 114 or MEC 111 or ESG 111 or (for students graduating with the Secondary Teacher Education option) MAE 330.
Note: MAT 331 and MAE 330 may be used both here and in Requirement 7.

5. Advanced linear algebra course: MAT 310 or MAT 315.

6. A course in abstract algebra: MAT 312 or MAT 313.

7. Analysis: Students must satisfy either a *or* b:

a. Three courses in analysis: MAT 319 or MAT 320 and two of the following: MAT 322, MAT 324, MAT 341, MAT 342
b. For students graduating with the Secondary Teacher Education option: MAT 319 or MAT 320.

8. Four mathematics-related courses beyond those taken to satisfy Requirements 2 through 6 (three will suffice if all of them are MAT courses), to be chosen from the following:

- • MAE 301
- MAT courses numbered 310 or above except MAT 475
- AMS courses numbered 301 or above except AMS 361 and AMS 475
- CSE courses numbered 301 or above except CSE 475
- CHE 301, CHE 302, CHE 351, CHE 353, ECO 320, ECO 321, ECO 348, PHY 301, PHY 302, PHY 303, PHY 306, PHY 308, PHY 403, PHY 405, PHY 408, PHI 330, ESE 310, ESE 315, ESE 319, ESE 321, or ESE 337.Students in the Secondary Teacher Education Program must fulfill a modified version of this requirement, consisting of AMS 310, MAT 336, MAT 360, and MAE courses.

B. Upper-Division Writing Requirement

To satisfy the Departmental writing requirement, each student majoring in Mathematics and following the D.E.C., including double majors, must submit an acceptable portfolio of three pieces of writing from upper-division MAT or MAE coursework. Students should aim for completion of the portfolio early in their next-to-last semester to allow time to resolve any difficulties. Late completion may delay graduation. Each portfolio must be submitted no later than the beginning of the final semester, and each piece in it must have been approved by a Departmental faculty member as being mathematically correct and well written.

Students following the Stony Brook Curriculum will fulfill the upper division writing requirement by completing the objectives for Writing within the Discipline (WRTD) and successful completion of MAT 319 or MAT 320 with a grade of C or better.

Notes:
1. Under special circumstances a student may request the director of undergraduate studies to allow substitution of an equivalent individual program for some or all of these requirements.
2. All courses used to fulfill the requirements for the major must be taken for a letter grade and must be completed with a grade of C or higher.
3. Students whose scores on the College Entrance Examination Board (CEEB) Advanced Placement Examination are documented earn credits as follows:

- 4 or 5 on BC examination: credit for MAT 131, MAT 132 (8 credits);
- 4 or 5 on AB examination: credit for MAT 131 (4 credits);
- 3 on either examination: 3 credits applicable o graduation but not the major.

4. Students who learned some linear algebra or multivariate calculus before entering Stony Brook should see an advisor in the Undergraduate Mathematics Office. For a student who has had some linear algebra, it may be appropriate to skip MAT 211 and to enroll directly in MAT 310.
5. Six credits of graduate MAT courses may be used in place of undergraduate courses in Requirement A7.

Honors Program in Mathematics

The honors program is open to junior and senior Mathematics majors who have completed at least two upper-division MAT courses with grades of B or higher and who have maintained a 3.00 overall grade point average. A prospective honors major must declare to the director of undergraduate studies an intention to participate in the program before registering for the senior year.

The program consists of a set of seven MAT courses, at least three of which are not used to fulfill the MAT major requirements. These courses must include: MAT 322 or MAT 324; MAT 401 or MAT 402; a course in algebra other than MAT 310; and MAT 495. Substitution of

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appropriate graduate courses is permitted, and other substitutions are possible at the discretion of the undergraduate director. Conferral of honors is contingent upon:

1. Completion of the set of seven courses with a grade point average of at least 3.50;
2. Approval for honors by the faculty member or members who supervise MAT 495.

Mathematics Secondary Teacher Education Program

See the Education and Teacher Certification entry.

Requirements for the Minor in Mathematics (MAT)

The minor in Mathematics is available for those students who want their formal university records to emphasize a serious amount of upper-division work in mathematics. Although a one-variable calculus sequence is not a requirement, it is a prerequisite for some of the courses listed below. The requirements listed below do not include single variable calculus or MAT 200 Logic, Language, and Proof; these are prerequisites for some of the courses listed below.

1. Either MAT 131 and MAT 132, or MAT 125 and MAT 126 and MAT 127, or AMS 151 and AMS 161, or MAT 141 and MAT 142, or MAT 171. Some or all of this requirement may be fulfilled by an appropriate score on the Mathematics Placement Exam, by AP credit, or by comparable means.
2. MAT 211 or AMS 210 or MAT 308
3. MAT 203 or AMS 261 or MAT 307
4. MAT 310 or MAT 312 or MAT 313
5. MAT 319 or MAT 320 or MAT 341 or MAT 342
6. Three additional MAT courses numbered 300 or higher (excluding 475)

All courses used to fulfill the requirements for the minor must be passed with a letter grade of C or higher

Beginning Mathematics Courses

The Mathematics curriculum begins with a choice of calculus sequences, some including preparatory material from 12th-year mathematics in high school and some not. The three first-term calculus courses that assume knowledge of 12th-year mathematics are MAT 125, MAT 131, MAT 141 and AMS 151. A student may start any of these with the same background.

The three-semester sequence of one-variable calculus, MAT 125, MAT 126, MAT 127, is academically equivalent to the two-semester sequence MAT 131, MAT 132. Engineering students normally take the faster-paced MAT 131, MAT 132, or AMS 151, AMS 161 rather than MAT 125, MAT 126, MAT 127 because of the many requirements they must meet. MAT 141, MAT 142 is an enriched version of MAT 131, MAT 132. MAT 171 is a version of MAT 142 for students who have not taken MAT 141; offered only in the fall semester.
MAT 122 and MAT 123 combine precalculus and calculus for students who have not had a precalculus course in high school. A student who completes MAT 122 will have learned some precalculus material and will have a good idea of what calculus is and how it is used. MAT 123 is designed to lead into MAT 125 or MAT 131. Although MAT 122 is not designed as preparation for further calculus courses, students may follow that course with MAT 125 or MAT 131 if they take the one-credit course MAT 130 in the same semester as MAT 125 or MAT 131.
MAT 118 is a non-calculus course that surveys various topics in mathematics that do not require a background in precalculus or calculus; it is designed for students who do not intend to take further courses in mathematics.
For students whose high school preparation is insufficient to begin the MAT curriculum, or to enroll in another course applicable to the D.E.C. category C requirement, Mathematical and Statistical Reasoning, there are two review courses numbered MAP 101 and MAP 103. These courses do not carry graduation credit. MAP 103, a skills course, is for students who need further work in high school algebra and related topics before continuing with calculus or other mathematics. Some students, upon completing MAP 103, are able to pass the Mathematics Placement Examination at a level that allows them to go directly into MAT 125 or MAT 131.

Placement

The Department of Mathematics offers a placement examination which indicates the level of mathematical preparation of each student. The score on the examination is used to place the student in appropriate courses in mathematics, applied mathematics and statistics, biology, computer science, chemistry, and physics. It tests the student's skills at the time the test is taken; students are advised to review their mathematics beforehand.
A student who wishes to use the placement examination to fulfill D.E.C. Category C, the QPS objective of the S.B.C, or other graduation-related requirements or Skill 1, or if they have been or wish to be accepted into a major in the College of Engineering and Applied Sciences, must take a proctored version of the examination. This examination is given regularly to incoming students prior to orientation, as well as several times during the academic year and by appointment with the Mathematics Department. An unproctored, online version of the exam can be given in the case where taking the proctored version prior to orientation is impractical; this version of the exam can be used only for registration purposes and may not be used to fulfill graduation requirements.
The placement exam consists of several parts; not all students will take all parts of the exam. Part I covers high school algebra, Part II deals with 12th year high school Mathematics (precalculus), and Part III covers single-variable calculus. The outcome of the test is one of nine levels:

Outcome	Placement
Level 1	MAP 101
Level 2	MAP 103
Level 2+	MAT 118 and Skill 1 or statistics
Level 3	MAT 118, MAT 123 or statistics

Level 4   MAT 125
Level 5   MAT 131 or MAT 141 or AMS 151
Level 6   MAT 126
Level 7   MAT 132 or MAT 142 or MAT 171 or AMS 161
Level 8   MAT 127 or MAT 132 or MAT 171 or MAT 142 or AMS 161
Level 9   Beyond 100-level calculus

Levels 1-3 can be achieved by a sufficiently high score on Part I, and levels 4-5 can be achieved by a sufficiently high score on Part II, and attaining levels 6-9 requires sufficiently high scores on Parts II and III. The entry skill in mathematics requirement may be satisfied by attaining a score of level 3 or higher on the proctored exam. The general education requirement for Mathematics (the Stony Brook Curriculum QPS objective, or D.E.C. category C) may be satisfied by attaining a score of level 6 or higher on the proctored exam. Certain majors will also accept a sufficiently high score on the proctored exam in lieu of required math courses.

A student who achieves a particular level is free to begin with a mathematics course corresponding to a lower level, so long as taking the course does not mean that credit is given for the same material twice.

Transfer Credit

When they enter, transfer students automatically receive credit toward graduation at Stony Brook for any courses they have already successfully completed at accredited institutions of higher education and that count toward graduation at that institution. The number of credits transferred appears on the Stony Brook transcript with no courses or grades indicated, and the number of transferred credits is unaffected by the student's score on the Mathematics Placement Examination. In some cases, a course designator ending in PQ (such as MAT 131PQ) may be placed on the student's transcript. In addition, transferred mathematics courses are automatically evaluated for applicability to the entry skill in mathematics requirement and the D.E.C. category C requirement; this evaluation does not depend on the result of the placement examination.

Sample Course Sequence for the Major in Mathematics
A course planning guide for this major may be found here. The major course planning guides are not part of the official Undergraduate Bulletin, and are only updated periodically for use as an advising tool. The Undergraduate Bulletin supersedes any errors or omissions in the major course planning guides.

FRESHMAN

FALL	Credits
First Year Seminar 101	1
WRT 101	3
MAT 131 or MAT 141 or MAT 125	3-4
SBC	3
SBC	3
SBC	3
Total	16-17

SPRING	Credits
First Year Seminar 102	1
WRT 102	3
MAT 132 or MAT 142 or MAT 171 or MAT 126	3-4
MAT 200 or Elective	3
SBC	3
SBC	3
Total	16-17

SOPHOMORE

FALL	Credits
MAT 203 or MAT 205 or AMS 261	3
MAT 211 or AMS 210	3
SBC	3
SBC	3

SBC	3
Total	15

SPRING	**Credits**
MAT 303 or MAT 305 or AMS 361	3
MAT 331	3
SBC	3
SBC	3
SBC	3
Total	15

JUNIOR

FALL	**Credits**
MAT 312 or MAT 313	3
MAT 319 or MAT 320	3
MAT 336	3
SBC	3
SBC	3
Total	15

SPRING	**Credits**
MAT 322 or MAT 341 or MAT 342 or MAT 324	3
MAT 310	3
SBC	3
Upper-division elective	3
Upper-division elective	3
Total	15

SENIOR

FALL	**Credits**
Upper-division MAT elective	3
Upper-division MAT elective	3
Upper-division MAT elective	3
SBC	3
SBC	3
Total	15

SPRING	**Credits**
Upper-division MAT elective	3
Upper-division MAT elective	3
Upper-division MAT elective	3
Elective	3
Elective	3

Total	15

MAE

Mathematics Teacher Preparation

MAE 301: Foundations of Secondary School Mathematics

A re-examination of elements of school mathematics, including topics in algebra, geometry, and elementary functions. Competence in basic secondary-level ideas and techniques are tested.

Prerequisites: MAT 200 and 211; admission to mathematics or applied mathematics secondary teacher preparation program Corequisite: MAE 311

3 credits

MAE 302: Methods and Materials for Teaching Secondary School Mathematics

The goals of mathematics education, learning theories, mathematics curricula, lesson planning, evaluation and teaching strategies. Lesson plans are drawn up and presented to the group.

Prerequisites: MAE 301 and C or higher in MAE 311
Pre- or Corequisite: MAE 312

SBC: CER, EXP+, SPK

3 credits

MAE 311: Introduction to Methods of Teaching Secondary School Mathematics

Aspects of teaching mathematics on the secondary school level, including lesson designs based on the NCTM standards, cooperative learning, and technology in mathematics education. Students observe classes in middle school and high school settings.

Prerequisites: MAT 211; admission to mathematics or applied mathematics secondary teacher preparation program; department consent Corequisite: MAE 301

3 credits

MAE 312: Micro-Teaching

Twice-weekly supervised classroom experience, tutoring, or working with small groups of students as a teacher's aide.

Prerequisite: C or higher in MAE 311
Pre- or Corequisite: MAE 302

SBC: CER, EXP+, SPK

2 credits

MAE 330: Technology in Mathematics Education

Introduces students in the secondary mathematics teacher preparation program to techniques and requirements for effective use of technology in the mathematics classroom. Emphasis on projects. Use of graphing calculators and computer software such as Geometer's Sketchpad.

Prerequisites: MAE 301 and 311

SBC: TECH

3 credits

MAE 400: Experiential Learning, Speak Effectively, Practice Critical and Ethical Reasoning

A zero credit course that may be taken in conjunction with any MAE course that provides opportunity to achieve the learning outcomes of the Stony Brook Curriculum's CER, EXP+, and SPK learning objectives.

Pre- or corequisite: WRT 102 or equivalent; permission of the instructor

SBC: CER, EXP+, SPK

0 credit, S/U grading

MAE 412: Issues in Teaching and Learning in Collegiate Mathematics

Investigation of the issues involved in the teaching and learning of introductory collegiate mathematics. A supervised teaching internship of undergraduate mathematics accompanies this seminar.

Prerequisite: MAE 302

4 credits

MAE 447: Directed Readings in Mathematics Education

Tutorial studies concerning current issues in mathematics education, including recent research and topics in the history of mathematics and their relation to teaching practice.

Pre- or Corequisite: MAE 312

1 credit

MAE 451: Supervised Teaching - Middle School Level Grades 7-9

Intensive supervised teaching in secondary schools. Students work in the school under the supervision of an experienced teacher.

Prerequisites: MAE 312; MAT 312, 319 and 360; AMS 310; permission of director of mathematics teacher education program Corequisites: MAE 452 and 454

SBC: CER, EXP+, SPK

6 credits, S/U grading

MAE 452: Supervised Teaching - High School Grades 10-12

Intensive supervised teaching in secondary schools. Students work in the school under the supervision of an experienced teacher.

Prerequisites: MAE 312; MAT 312, 319 and 360; AMS 310; permission of director of mathematics teacher education program Corequisites: MAE 451 and 454

SBC: CER, EXP+, SPK

6 credits, S/U grading

MAE 454: Student Teaching Seminar

Weekly discussions of teaching techniques and experiences, learning theory, curriculum content, and classroom problems.

Corequisites: MAE 451 and 452

SBC: CER, EXP+, SPK

3 credits

MAP

Mathematics Proficiency

MAP 101: Fundamentals of Arithmetic and Algebra

Arithmetic: fractions, decimals, and percent. Algebra: signed numbers, monomials, linear equations in one unknown, and word problems. This course is intended for students who have never studied algebra. Does not satisfy the entry skill in mathematics requirement or the D.E.C. category C requirement. Students who have otherwise satisfied D.E.C. category C may not register for this course. Overqualified students as determined by a placement test may be deregistered and directed to transfer to another course. Does not count toward graduation. A through C/Unsatisfactory grading only. The Pass/No Credit option may not be used.

3 credits

MAP 103: Proficiency Algebra

An intensive review of high school algebra as preparation for calculus and other mathematics. Facility with exponents, basic graphing, solving linear and quadratic equations in one variable, solving linear systems in two variables, polynomials, factorization of algebraic expressions, binomial theorem, and inequalities. Algebraic manipulations, analytic geometry of lines. Does not count toward graduation. A through C/Unsatisfactory grading only. The Pass/No Credit option may not be used. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering

for HD/CA courses for the first time will have priority to do so.

Prerequisite: Level 2 on the mathematics placement examination or MAP 101

DEC: S1

3 credits

MAT

Mathematics

MAT 118: Mathematical Thinking

Development of quantitative thinking and problem solving abilities through a selection of mathematical topics: logic and reasoning; numbers, functions, and modeling; combinatorics and probability; growth and change. Other topics may include geometry, statistics, game theory, and graph theory. Through their engagement in problem solving, students develop an appreciation of the intellectual scope of mathematics and its connections with other disciplines.

Prerequisite: C or better in MAP 103 or level 2+ or higher on the mathematics placement examination
(Prerequisite must be met within one year of beginning this course.)

DEC: C
SBC: QPS

3 credits

MAT 122: Overview of Calculus with Applications

The basics of calculus in a self-contained, one-semester course. Properties and applications of polynomial, exponential, and logarithmic functions. Derivatives: slopes, rates of change, optimization, integrals, area, cumulative change, and average. The fundamental theorem of calculus. Emphasis on modeling examples from economics. Students who subsequently wish to enroll in MAT 125 or 131 will be required to score level 4 on the mathematics placement examination before taking either course. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: C or better in MAP 103 or level 3 on the mathematics placement exam (Prerequisite must be met within one year prior to beginning the course.)

DEC: C
SBC: QPS

3 credits

MAT 123: Precalculus

Comprehensive preparation for the regular calculus sequences. Careful development of rational, exponential, logarithmic, and trigonometric functions, and their applications. Asymptotics and curve sketching. General modeling examples. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: C or better in MAP 103 or level 3 on the mathematics placement exam (Prerequisite must be met within one year prior to beginning the course.)

DEC: C
SBC: QPS

3 credits

MAT 125: Calculus A

Differential calculus, emphasizing conceptual understanding, computations and applications, for students who have the necessary background from 12th-year high school mathematics. Limits and continuous functions. Differentiation of elementary algebraic, trigonometric, exponential and logarithmic functions; graphing; modeling; and maximization. L'Hospital's rule. May not be taken for credit in addition to MAT 131 or 141 or AMS 151. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: C or higher in MAT 123; or level 4 on the mathematics placement examination

DEC: C
SBC: QPS

3 credits

MAT 126: Calculus B

A continuation of MAT 125, covering integral calculus: Riemann sums, the fundamental theorem, symbolic and numeric methods of integration, area under a curve, volume, applications such as work and probability, improper integrals. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: C or higher in MAT 125 or 131 or 141 or AMS 151 or level 6 on the mathematics placement examination

DEC: C
SBC: QPS

3 credits

MAT 127: Calculus C

A continuation of MAT 126, covering: sequences, series, Taylor series, differential equations and modeling. May not be taken for credit in addition to MAT 132, MAT 142, MAT 171, or AMS 161. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: C or higher in MAT 126 or level 8 on the mathematics placement examination

DEC: C
SBC: QPS

3 credits

MAT 131: Calculus I

The differential calculus and integral calculus, emphasizing conceptual understanding, computations and applications, for students who have the necessary background from 12th-year high school mathematics. Differentiation of elementary algebraic; trigonometric, exponential, and logarithmic functions; graphing; modelling and maximization; L'Hospital's rule; the Riemann integral; and the Fundamental Theorem of Calculus. May not be taken for credit in addition to MAT 125 or 141 or AMS 151. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: B or higher in MAT 123 or level 5 on the mathematics placement examination

DEC: C
SBC: QPS

4 credits

MAT 132: Calculus II

A continuation of MAT 131, covering symbolic and numeric methods of integration; area under a curve; volume; applications such as work and probability; sequences; series; Taylor series; differential equations; and modelling. May not be taken for credit in addition to MAT 127, MAT 142, MAT 171, or AMS 161. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: C or higher in AMS 151 or MAT 131 or 141, or level 7 on the mathematics placement examination

DEC: C
SBC: QPS

4 credits

MAT 141: Analysis I

A careful study of the theory underlying calculus. The development of the real number system, limits and infinite sequences, functions of one real variable, continuity, differentiability, the Riemann integral, and the Fundamental Theorem of Calculus. Full attention to proofs is given. All topics in MAT131 are included, although the presentation differs significantly. May not be taken for credit in addition to MAT 125, MAT 131, or AMS 151. A student who successfully completes both MAT 141 and 142 will receive equivalency for MAT 320. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: Level 5 on the mathematics placement examination; priority given to students in the University's honors programs

DEC: *C*
SBC: *QPS*

4 credits

MAT 142: Analysis II

A continuation of MAT 141 in the same spirit, including the topics of MAT 132 but with attention to theory and including proofs of major theorems: techniques and applications of integration, infinite series, Taylor series, modelling and elementary differential equations. A student who successfully completes both MAT 141 and MAT 142 will receive a waiver for MAT 320. May not be taken for credit in addition to MAT 127, MAT 171, or AMS 161. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: C or higher in MAT 141 or permission of the Advanced Track Committee

SBC: *QPS*

4 credits

MAT 160: Mathematical Problems and Games

Intended for students interested in sharpening their problem-solving skills and in developing their ability to express mathematical ideas.

1 credit, S/U grading

MAT 171: Accelerated Single-Variable Calculus

A single semester, honors-level, course which reviews the material in MAT 131 in a few weeks, then concentrates on the topics covered in MAT 132, with additional attention paid to the underlying theory. Primarily intended for students who have had calculus in high school.

May not be taken for credit in addition to MAT 126, MAT 127, MAT 132, MAT 142, or AMS 161.

Prerequisites: Level 5 on the AB Calculus AP exam, Level 3 on the BC Calculus exam, A or A- in MAT 131 or AMS 151, MAT 141, or level 7 on the mathematics placement exam. Priority given to students in the University's honors programs.

DEC: *C*
SBC: *QPS*

4 credits

MAT 200: Logic, Language and Proof

A basic course in the logic of mathematics, the construction of proofs and the writing of proofs. The mathematical content is primarily logic and proofs, set theory, combinatorics, functions and relations. There is considerable focus on writing. May not be taken for credit in addition to MAT 250.

Prerequisite: Level 4 on the mathematics placement examination or equivalent course or permission of the instructor

SBC: *STEM+*

3 credits

MAT 203: Calculus III with Applications

Vector algebra in two and three dimensions, multivariate differential and integral calculus, optimization, vector calculus including the theorems of Green, Gauss, and Stokes. Applications to economics, engineering, and all sciences, with emphasis on numerical and graphical solutions; use of graphing calculators or computers. May not be taken for credit in addition to AMS 261.

Prerequisite: C or higher in MAT 127 or 132 or 142 or AMS 161 or level 9 on the mathematics placement examination

SBC: *STEM+*

4 credits

MAT 211: Introduction to Linear Algebra

Introduction to the theory of linear algebra with some applications; vectors, vector spaces, bases and dimension, applications to geometry, linear transformations and rank, eigenvalues and eigenvectors, determinants and inner products. May not be taken for credit in addition to AMS 210.

Prerequisite: C or higher in AMS 151 or MAT 131 or 141 or coregistration in MAT 126 or level 7 on the mathematics placement examination

SBC: *STEM+*

3 credits

MAT 220: Linear Algebra and Geometry

Vectors and vector algebra. Dot product. Cross product and triple product. Analytic geometry. Vector equations of lines and planes. Curves and surfaces of degree two. Complex numbers. Linear spaces and linear maps. Matrices, systems of linear equations. Isomorphisms of vector spaces, bases and dimension. MAT 220 is primarily intended for students in the Advanced Track program. It serves as an alternative to MAT 211 and may not be taken for credit in addition to MAT 211.

Prerequisite: MAT 131 or an equivalent course or level 7 or higher on mathematics placement examination or permission of the Advanced Track Committee
Corequisite: MAT 250

SBC: *STEM+*

3 credits

MAT 250: Introduction to Advanced Mathematics

An introduction to the Advanced Track mathematics program. Provides the core of basic of propositional logic, quantifiers, proofs, sets, functions, cardinality, relations, equivalence relations and quotient sets, order relations, combinatorics. Number systems: natural numbers, integers, rational, real and complex numbers. MAT 250 is primarily intended for students in the Advanced Track program. It serves as an alternative to MAT 200 and may not be taken for credit in addition to MAT 200. Formerly offered as MAT 150; not for credit in addition to MAT 150.

Prerequisite: MAT 131 or an equivalent course or level 7 or higher on mathematics placement examination or permission of the Advanced Track Committee.
Corequisite: MAT 220

SBC: *QPS*

4 credits

MAT 260: Problem Solving in Mathematics

Students actively solve challenging problems in plane geometry, basic number theory, and calculus, and write precise arguments. Relevant preparation for problem-solving is provided in the course.

Prerequisite: Permission of instructor
1 credit

MAT 303: Calculus IV with Applications

Homogeneous and inhomogeneous linear differential equations; systems of linear differential equations; series solutions; Laplace transforms; Fourier series. Applications to economics, engineering, and all sciences with emphasis on numerical and graphical

solutions; use of computers. May not be taken for credit in addition to AMS 361 or MAT 308.

Prerequisite: C or higher in MAT 127 or 132 or 142 or AMS 161 or level 9 on the mathematics placement examination

SBC: STEM+

4 credits

MAT 307: Multivariable Calculus with Linear Algebra

Introduction to linear algebra: vectors, matrices, systems of linear equations, bases and dimension, dot product, determinants. Multivariate differential and integral calculus, divergence and curl, line and surface integrals, theorems of Green, Gauss, and Stokes. More theoretical and intensive than MAT 203, this course is primarily intended for math majors. Together with MAT 308, it forms a 2-semester sequence covering the same material as the 3-semester sequence of MAT 203, MAT 211 and MAT 303. May not be taken for credit in addition to MAT 203 or AMS 261.

Prerequisite: MAT 127 or MAT 132

SBC: STEM+

4 credits

MAT 308: Differential Equations with Linear Algebra

Linear algebra: determinants, eigenvalues and eigenvectors, diagonalization. Differential equations; existence and uniqueness of solutions. First- and second-order equations; linear versus nonlinear equations. Systems of linear equations. Laplace transform. Applications to physics. More theoretical and intensive than MAT 303, this course is primarily intended for math majors. Together with MAT 307, it forms a 2-semester sequence covering the same material as the 3-semester sequence of MAT 205, MAT 211 and MAT 305. May not be taken for credit in addition to MAT 303 or AMS 361.

Prerequisite: MAT 307; or MAT 203 and MAT 211; or MAT 132 and MAT 220; or permission of instructor

SBC: STEM+

4 credits

MAT 310: Linear Algebra

Finite dimensional vector spaces, linear maps, dual spaces, bilinear functions, inner products. Additional topics such as canonical forms, multilinear algebra, numerical linear algebra.

Prerequisite: C or higher in MAT 211 or 308 or AMS 210 or MAT 220; C or higher in MAT 200 or MAT 250 or permission of instructor

4 credits

MAT 311: Number Theory

Congruences, quadratic residues, quadratic forms, continued fractions, Diophantine equations, number-theoretical functions, and properties of prime numbers.

Prerequisites: C or higher in MAT 312 or 313; C or higher in MAT 200 or MAT 250 or permission of instructor

3 credits

MAT 312: Applied Algebra

Topics in algebra: groups, informal set theory, relations, homomorphisms. Applications: error correcting codes, Burnside's theorem, computational complexity, Chinese remainder theorem. This course is offered as both AMS 351 and MAT 312.

Prerequisite: C or higher in AMS 210 or MAT 211 or MAT 220
Advisory Prerequiste: MAT 200 or CSE 113

3 credits

MAT 313: Abstract Algebra

Groups and rings together with their homomorphisms and quotient structures. Unique factorization, polynomials, and fields.

Prerequisite: C or higher in MAT 310 or MAT 312 or MAT 315; C or higher in MAT 200 or MAT 250 or permission of instructor

3 credits

MAT 314: Abstract Algebra II

This course is a continuation of MAT 313, Abstract algebra. It covers modules over rings, including structure theorem for modules over PID, theory of fields and field extensions and introduction to Galois theory.

Prerequisite: MAT 313 or permission of the instructor

3 credits

MAT 315: Advanced Linear Algebra

Finite dimensional vector spaces over a field, linear maps, isomorphisms, dual spaces, quotient vector spaces, bilinear and quadratic functions, inner products, canonical forms of linear operators, multilinear algebra, tensors. This course serves as an alternative to MAT 310. It is an intensive course, primarily intended for math majors in Advanced Track program.

Prerequisite: B or higher in MAT 200 or MAT 250, and B or higher in MAT 220, or permission of the instructor

4 credits

MAT 319: Foundations of Analysis

A careful study of the theory underlying topics in one-variable calculus, with an emphasis on those topics arising in high school calculus. The real number system. Limits of functions and sequences. Differentiations, integration, and the fundamental theorem. Infinite series.

Prerequisite: C or higher in MAT 200 or MAT 250 or permission of instructor; C or higher in one of the following: MAT 203, 211, 220, 307, AMS 261, or A- or higher in MAT 127, 132, 142, or AMS 161

4 credits

MAT 320: Introduction to Analysis

A careful study of the theory underlying calculus. The real number system. Basic properties of functions of one real variable. Differentiation, integration, and the inverse theorem. Infinite sequences of functions and uniform convergence. Infinite series. Metric spaces and compactness. This course is a more demanding alternative of MAT 319, suitable for students who are comfortable with rigorous proofs.

Prerequisite: B or higher in MAT 200 or MAT 250 or permission of instructor; C or higher in one of the following: MAT 203, 211, 220, 307, AMS 261, or A- or higher in MAT 127, 132, 142, or AMS 161

4 credits

MAT 322: Analysis in Several Dimensions

Continuity, differentiation, and integration in Euclidean n-space. Differentiable maps. Implicit and inverse function theorems. Differential forms and the general Stokes's theorem.

Prerequisites: C or higher in MAT 203, MAT 220, MAT 307, or AMS 261; C or higher in MAT 310 or MAT 315; B or higher in MAT 320

3 credits

MAT 324: Real Analysis

Introduction to Lebesgue measure and integration. Aspects of Fourier series, function spaces, Hilbert spaces, Banach spaces.

Prerequisites: B or higher in MAT 320

3 credits

MAT 331: Computer-Assisted Mathematical Problem Solving

Exploration of the use of the computer as a tool to gain insight into complex mathematical problems through a project-oriented approach. Students learn both the relevant mathematical concepts and ways that the computer can be used (and sometimes misused) to understand them. The particular problems may vary by semester; past topics have included cryptography, fractals and recursion, modeling

the flight of a glider, curve fitting, the Brachistochrone, and computer graphics. No previous experience with computers is required.

Prerequisite: C or higher in MAT 203 or 205 or 307 or AMS 261

SBC: TECH

3 credits

MAT 336: History of Mathematics

A survey of the history of mathematics from the beginnings through the 19th century, with special attention to primary sources and to the interactions between culture and mathematics. Emphasis on topics germane to the high school curriculum. Mesopotamian, Egyptian, and Greek mathematics; non-European mathematics; early Renaissance mathematics; the birth and flowering of calculus; the beginnings of probability theory; and the origin of non-Euclidean geometries and the modern concept of number.

Prerequisite: MAT 200 or MAT 203 or or MAT 250 or MAT 307 or AMS 261

DEC: H
SBC: SPK, STAS, WRTD

3 credits

MAT 341: Applied Real Analysis

Partial differential equations of mathematical physics: the heat, wave, and Laplace equations. Solutions by techniques such as separation of variables using orthogonal functions (e.g., Fourier series, Bessel functions, Legendre polynomials). D'Alembert solution of the wave equation.

Prerequisites: C or higher in the following: MAT 203 or 220 or 307 or AMS 261; MAT 303 or 305 or 308 or AMS 361
Advisory Prerequisite: MAT 200 or MAT 250

3 credits

MAT 342: Applied Complex Analysis

Complex numbers, analytic functions, the Cauchy-Riemann and Laplace equations, the Cauchy integral formula and applications. Fundamental Theorem of Algebra and the Maximum Principle. The Cauchy residue theorem and applications to evaluating real integrals. Conformal mappings.

Prerequisite: C or higher in the following: MAT 203 or MAT 220 or MAT 307 or AMS 261
Advisory Prerequisite: MAT 200 or MAT 250

3 credits

MAT 351: Differential Equations: Dynamics and Chaos

A study of the long-term behavior of solutions to ordinary differential equations or of iterated

mappings, emphasizing the distinction between stability on the one hand and sensitive dependence and chaotic behavior on the other. The course describes examples of chaotic behavior and of fractal attractors, and develops some mathematical tools for understanding them.

Prerequisites: C or higher in the following: MAT 203 or MAT 220 or MAT 307 or AMS 261; MAT 303 or MAT 308 or AMS 361; MAT 200 or MAT 250 or permission of instructor

3 credits

MAT 360: Geometric Structures

Formal geometries and models. Topics selected from projective, affine, Euclidean, and non-Euclidean geometries.

Pre- or Corequisites: MAT 203 or 220 or 307 or AMS 261; MAT 200 or MAT 250 or permission of instructor

3 credits

MAT 362: Differential Geometry of Surfaces

The local and global geometry of surfaces: geodesics, parallel transport, curvature, isometries, the Gauss map, the Gauss-Bonnet theorem.

Prerequisite: C or higher in MAT 319 or MAT 320 or MAT 364; MAT 203 or MAT 307 or MAT 322

3 credits

MAT 364: Topology and Geometry

A broadly based introduction to topology and geometry, the mathematical theories of shape, form, and rigid structure. Topics include intuitive knot theory, lattices and tilings, non-Euclidean geometry, smooth curves and surfaces in Euclidean 3-space, open sets and continuity, combinatorial and algebraic invariants of spaces, higher dimensional spaces.

Prerequisites: MAT 203 or 220 or 307 or AMS 261; MAT 200 or 250
Advisory Prerequisite: MAT 319 or 320

3 credits

MAT 371: Logic

A survey of the logical foundations of mathematics: development of propositional calculus and quantification theory, the notions of a proof and of a model, the completeness theorem, Goedel's incompleteness theorem. This course is offered as both CSE 371 and MAT 371.

Prerequisite: CSE 150 or CSE 215 or MAT 200 or MAT 250

3 credits

MAT 373: Analysis of Algorithms

Mathematical analysis of a variety of computer algorithms including searching, sorting, matrix multiplication, fast Fourier transform, and graph algorithms. Time and space complexity. Upper-bound, lower- bound, and average-case analysis. Introduction to NP completeness. Some machine computation is required for the implementation and comparison of algorithms. This course is offered as CSE 373 and MAT 373.

Prerequisites: C or higher in MAT 211 or AMS 210; CSE 214 or CSE 260

3 credits

MAT 401: Seminar in Mathematics

Discussions of a specific area of interest in mathematics. The work of each semester covers a different area of mathematics. May be repeated as topic changes. Prerequisites will be announced with the topic each time the course is offered.

Prerequisites: U3 or U4 standing; additional prerequisites announced with topic

SBC: SPK

3 credits

MAT 402: Seminar in Mathematics

Discussions of a specific area of interest in mathematics. The work of each semester covers a different area of mathematics. May be repeated as topic changes. Prerequisites will be announced with the topic each time the course is offered.

Prerequisites: U3 or U4 standing; additional prerequisites announced with topic

SBC: SPK

3 credits

MAT 425: How to teach remedial mathematics

Provides knowledge and skills for teaching college remedial mathematics classes. It includes analysis of difficulties that students encounter in the mathematical college courses of initial levels. In it, precollege mathematics is revisited, its usage in college courses is discussed, and, on the basis of this concrete material, students are taught how to detect and treat typical mistakes and misconceptions, how to compose problems and tests, how to analyze and assess pro-actively students# works, and how to organize lessons in the environment of students with diverse challenges and needs. Students will learn how to present mathematics clearly and mathematically correct both verbally and in writing.

Prerequisite: MAT 200 and grade B or higher in one of the Calculus classes

3 credits

MAT 444: Experiential Learning

This course is designed for students who engage in a substantial, structured experiential learning activity in conjunction with another class. Experiential learning occurs when knowledge acquired through formal learning and past experience are applied to a "real-world" setting or problem to create new knowledge through a process of reflection, critical analysis, feedback and synthesis. Beyond-the-classroom experiences that support experiential learning may include: service learning, mentored research, field work, or an internship.

Prerequisite: WRT 102 or equivalent; permission of the instructor and approval of the EXP+ contract (http://sb.cc.stonybrook.edu/bulletin/current/policiesandregulations/degree_requirements/EXPplus.php)

SBC: EXP+

0 credit, S/U grading

MAT 458: Speak Effectively Before an Audience

A zero credit course that may be taken in conjunction with any MAT course that provides opportunity to achieve the learning outcomes of the Stony Brook Curriculum's SPK learning objective.

Pre- or corequisite: WRT 102 or equivalent; permission of the instructor

SBC: SPK

0 credit, S/U grading

MAT 459: Write Effectively in Mathematics

A zero credit course that may be taken in conjunction with any 300- or 400-level MAT course, with permission of the instructor. The course provides opportunity to practice the skills and techniques of effective academic writing and satisfies the learning outcomes of the Stony Brook Curriculum's WRTD learning objective.

Prerequisite: WRT 102; permission of the instructor

SBC: WRTD

0 credit, S/U grading

MAT 475: Undergraduate Teaching Practicum

Each student assists in teaching a lower-division mathematics course or works in the Mathematics Learning Center. The student's work is regularly supervised by a faculty member. In addition, a weekly seminar is conducted. Responsibilities may include preparation of materials for student use and discussions, helping students with problems, and involvement in "alternative" teaching projects. Intended for upper-division students who have excelled in the calculus sequence. May not be used for major credit.

Prerequisite: Permission of the director of undergraduate studies

SBC: EXP+

3 credits, S/U grading

MAT 487: Independent Study in Special Topics

A reading course for juniors and seniors. The topics may be chosen by the student with the approval of a supervising member of the faculty, who also takes responsibility for evaluation. A topic that is covered in a course regularly offered by the department is not appropriate for independent study. May be repeated.

Prerequisite: Permission of the director of undergraduate studies

0-6 credits

MAT 495: Honors Thesis

The student and a supervising faculty member together choose a topic in mathematics, and the student writes a substantial paper expounding the topic in a new way.

Prerequisite: Permission of the director of undergraduate studies

SBC: EXP+, WRTD

3 credits