# Mathematics Major

## Program Requirements

- **Total Units Required:** 42
- **Grade Requirement:** All required courses (both lower- and upper-level) must be taken for a letter grade and completed with a grade of C– or higher.

## Required Courses

- The three-course calculus sequence (9 units)* and an introductory computing course (3 units)**:

| Code | Title | Units |
|---|---|---|
| MATH 1510 | Calculus I | 3 |
| MATH 1520 | Calculus II | 3 |
| MATH 2130 | Calculus III | 3 |
| CSE 1301 | Introduction to Computer Science | 3 |
| or ENGR 1201 | Introduction to Engineering Computing | |
| **Total Units** | | **12** |

* AP credit may be applied in place of MATH 1510 Calculus I and/or MATH 1520 Calculus II. Students who have completed MATH 2801 Honors Mathematics I and MATH 2802 Honors Mathematics II will be considered to have fulfilled the calculus-sequence requirement.

**This course may be waived after consultation with the director of undergraduate studies of the Department of Computer Science & Engineering.

- The following required upper-level courses (24 units):*

| Code | Title | Units |
|---|---|---|
| MATH 3010 | Foundations for Higher Mathematics | 3 |
| or MATH 3015 | Foundations for Higher Mathematics With Writing | |
| MATH 4101 | Real Analysis I | 3 |
| MATH 4102 | Real Analysis II | 3 |
| MATH 4160 | Complex Variables | 3 |
| MATH 4201 | Topology I | 3 |
| MATH 4301 | Linear Algebra | 3 |
| MATH 4302 | Modern Algebra | 3 |
| *At least one of the following:* | | |
| MATH 4202 | Topology II | 3 |
| MATH 4220 | An Introduction to Differential Geometry | 3 |
| MATH 4350 | Number Theory and Cryptography | 3 |
| MATH 4540 | Partial Differential Equations | 3 |

* Students who take MATH 2801 and MATH 2802 are recommended to bypass MATH 3010/MATH 3015, for which they may substitute any other upper-level Mathematics course.

- Two additional upper-level (numbered 3000 or higher) Mathematics courses that have not been used to fulfill any other requirement (6 units).

# Additional Information

## Course Substitutions

At most one approved substitution can be made using a course outside the Department of Mathematics.

In general, the following courses can count as upper-level Mathematics electives, but specifics may vary for the various programs in the department (e.g., majors requiring all electives to be taken from a specific list):

| Code | Title | Units |
|---|---|---|
| ENGR 3190 | Engineering Mathematics B | 3 |
| PHYSICS 5010 | Theoretical Physics | 3 |
| PHYSICS 5020 | Methods of Theoretical Physics II | 3 |
| SDS 4010 | Probability | 3 |
| SDS 4070 | Stochastic Processes | 3 |

## Additional Requirements

1. A student cannot declare more than one major or minor in the department. This restriction includes dual majors, such as Mathematics and Economics and Mathematics and Computer Science. These majors are considered "in the department" even if they are declared in another department.
2. No *upper-level* course used to satisfy a major requirement can be counted toward the requirements of any other major or minor (i.e., no double-counting of courses).
3. At most 3 units of independent study or research work can count toward the major requirements.
4. Students may count courses from the Department of Statistics and Data Science (SDS) as Mathematics courses if the student matriculated in 2023-24 or earlier and if the course was previously offered by the Department of Mathematics and Statistics, as reflected by the student's matriculation-year Bulletin.
5. At most one of the following courses can be used to fulfill major requirements: MATH 3180 Introduction to Calculus of Several Variables or MATH 3550 Mathematics for the Physical Sciences.
6. Courses transferred from other accredited colleges and universities can be counted, with the following caveats, if they receive department approval:
   a. Courses transferred from a two-year college (e.g., a community college) cannot be used to satisfy upper-level requirements.
   b. At least half of the upper-level units required in a major must be earned at Washington University or in a Washington University-approved overseas study program.
   c. Courses from the School of Continuing & Professional Studies cannot be used to fulfill major requirements.

# Latin Honors

At the time of graduation, the Department of Mathematics will recommend that a candidate receive Latin Honors (*cum laude*, *magna cum laude*, or *summa cum laude*) if that student has completed the department's requirements for High Distinction or Highest Distinction in Mathematics, including an Honors Thesis. The actual award of Latin Honors is managed by the College of Arts & Sciences.

# The Honors Thesis

Arts & Sciences mathematics majors who want to be candidates for Latin Honors, High Distinction, or Highest Distinction must complete an honors thesis. Writing an honors thesis involves a considerable amount of independent work, reading, creating mathematics, writing a paper that meets acceptable professional standards, and making an oral presentation of the results.

## Types of Projects

An honors thesis can take two forms:

1. A thesis that presents significant work by the student on one or more nontrivial mathematics problems.
2. A substantial expository paper that follows independent study on an advanced topic under the guidance of a department faculty member. Such a report would involve the careful presentation of ideas and the synthesis of materials from several sources.

## Process and Suggested Timeline

### Junior Year, Spring Semester

1. Talk with a faculty advisor about possible projects.
2. Complete the Honors Proposal Form and submit it to Blake Thornton.

### Senior Year

1. By the end of January, provide the advisor with a draft abstract and outline of the paper.
2. By the end of February, submit a rough draft, including an abstract, to the advisor.
3. The student and the advisor should agree on a date that the writing will be complete and on a date and time for the oral presentation in mid-March (the deadline is March 31).

# Departmental Prizes

Each year, the department considers graduating majors for two departmental prizes and also awards a prize to juniors. Recipients are recognized at an annual awards ceremony in April where graduating majors each receive a certificate and a set of honors cords to be worn as part of the academic dress at Commencement. Awards are noted on the student's permanent university record.

## Ross Middlemiss Prize

The Ross Middlemiss Prize is awarded to a graduating major with an outstanding record. The award was established by former Professor Ross Middlemiss, who taught at Washington University for 40 years. Middlemiss authored several books, including a widely popular calculus text that was used in courses offered by the School of Continuing & Professional Studies until the late 1970s.

## Martin Silverstein Award

The Martin Silverstein Award was established in memory of Professor Martin Silverstein, who, until his death in 2004, was a pioneer in work at the interface of probability theory and harmonic analysis. Graduating students completing any major we offer will be considered for this award, but preference is given to those who have done excellent work in applied mathematics or analysis.

## Brian Blank Award

The Brian Blank Award was established in memory of Professor Brian Blank, who passed away in 2018. Each year, the Department of Mathematics selects distinguished juniors who have declared a major in the department to receive this award.

# Distinctions in Mathematics

## Distinction

- Complete at least 33 units of upper-level Mathematics courses.
- The GPA for these 33 upper-level units must be at least 3.7. If more than 33 units are taken for a letter grade, the courses with the lowest grades can be omitted when computing the GPA for this purpose.
- Complete at least five courses numbered 4000 or higher, each with a grade of B or higher.
- All of these courses must be classroom courses (not independent study or study for honors), and they must all be taken for a letter grade.

## High Distinction

- Complete all requirements for Distinction.
- Complete an honors thesis.

## Highest Distinction

- Complete all requirements for High Distinction.
- Complete at least five courses numbered 4000 or higher, each with a grade of B+ or higher. These courses can be the same five courses used for the Distinction requirement, but the grades must be B+ or higher.
- Complete one of the two paths described below:

- *Graduate Qualifier Path:* Graduate qualifying courses* in Mathematics are two- or three-semester sequences that start in the fall, with a qualifying exam held at the end of each semester. Students must complete and pass two qualifying courses* and their corresponding qualifying exams. (These can be consecutive courses in the same sequence, or they can be courses from two different sequences.)
- *Coursework Path:*
  - Complete at least 42 units of upper-level Mathematics courses. The GPA for these 42 upper-level units must be at least 3.7. If more than 42 units are taken for a letter grade, the courses with the lowest grades can be omitted when computing the GPA for this purpose.
  - Complete at least nine total courses numbered 4000 or higher, all with a grade of B+ or higher. These courses can include the five courses taken for Distinction. All of these courses must be classroom courses (not independent study or study for honors), and they must all be taken for a letter grade.

* These qualifying courses can count toward the additional course requirements for Distinction.

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