MATHEMATICS, B.S. (SCIENCE)

Begin Campus: Any Penn State Campus
End Campus: University Park

Degree Requirements
For the Bachelor of Science degree in Mathematics, a minimum of 120 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Electives</td>
<td>0-1</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>80-83</td>
</tr>
</tbody>
</table>

6 of the 45 credits for General Education are included in the Requirements for the Major. This includes 6 General Education GQ courses.

General Education
Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (http://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)
- Quantification (GQ): 6 credits
- Writing and Speaking (GWS): 9 credits

Knowledge Domains
- Arts (GA): 6 credits
- Health and Wellness (GHW): 3 credits
- Humanities (GH): 6 credits
- Social and Behavioral Sciences (GS): 6 credits
- Natural Sciences (GN): 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)
- Inter-Domain or Approved Linked Courses: 6 credits

University Degree Requirements
First Year Engagement
All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement
6 credits are required and may satisfy other requirements
- United States Cultures: 3 credits
- International Cultures: 3 credits

Writing Across the Curriculum
3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits
A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work
Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition
The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80)). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major
To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44).

Common Requirements for the Major (All Options)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 200</td>
<td>Elementary Statistics</td>
<td>4</td>
</tr>
<tr>
<td>PRESCRIBED COURSES: REQUIRE A GRADE OF C OR BETTER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 140</td>
<td>Calculus With Analytic Geometry I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 141</td>
<td>Calculus with Analytic Geometry II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 220</td>
<td>Matrices</td>
<td>2</td>
</tr>
<tr>
<td>MATH 230</td>
<td>Calculus and Vector Analysis</td>
<td>4</td>
</tr>
<tr>
<td>MATH 311W</td>
<td>Concepts of Discrete Mathematics</td>
<td>3-4</td>
</tr>
<tr>
<td>MATH 312</td>
<td>Concepts of Real Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

Additional Courses
Select one of the following:
- CMPSC 101 | Introduction to Programming             |
- CMPSC 121 | Introduction to Programming Techniques   |
- CMPSC 201 | Programming for Engineers with C++       |
Mathematics, B.S. (Science)

Additional Courses: Require a grade of C or better
MATH 250 Ordinary Differential Equations 3-4
or MATH 251 Ordinary and Partial Differential Equations

Requirements for the Option
Select an option 50-51

Requirements for the Option
Actuarial Mathematics Option (50-51 credits)
Available at the following campuses: University Park

Code Title Credits
Prescribed Courses
IE 425 Stochastic Models in Operations Research 3
MATH 414 Introduction to Probability Theory 3
MATH 415 Introduction to Mathematical Statistics 3
MATH 416 Stochastic Modeling 3
MATH 484 Linear Programs and Related Problems 3
RM 302 Risk and Insurance 3
RM 410 Financial Mathematics for Actuaries 3
RM 411 Actuarial Mathematics I 3
RM 412 Actuarial Mathematics II 3
STAT 462 Applied Regression Analysis 3

Additional Courses
Additional Courses: Require a grade of C or better
MATH 411 Ordinary Differential Equations
MATH 416 Stochastic Modeling
MATH 417 Qualitative Theory of Differential Equations
MATH 419 Theoretical Mechanics
MATH 421 Complex Analysis
MATH 456 Introduction to Numerical Analysis II
MATH 461
MATH 467 Factorization and Primality Testing
MATH 468 Mathematical Coding Theory
MATH 479 Special and General Relativity
MATH 484 Linear Programs and Related Problems
MATH 485 Graph Theory
MATH 486 Mathematical Theory of Games

Select 3 credits from STAT 463 or 400-level MATH courses except:
- MATH 401
- MATH 405
- MATH 406
- MATH 441
- MATH 470
- MATH 471

Supporting Courses and Related Areas
Select 14-15 credits from department list 14-15

Applied and Industrial Mathematics Option (50-51 credits)
Available at the following campuses: University Park

Code Title Credits
Prescribed Courses
MATH 403 Classical Analysis I 3
MATH 412 Fourier Series and Partial Differential Equations 3
MATH 414 Introduction to Probability Theory 3
MATH 415 Introduction to Mathematical Statistics 3
MATH 436 Linear Algebra 3
MATH 450 Mathematical Modeling 3
MATH 455 Introduction to Numerical Analysis I 3

Additional Courses
Additional Courses: Require a grade of C or better
Select 12 credits of the following: 12

Select 3 credits of the following:
- MATH 411
- MATH 416
- MATH 417
- MATH 419
- MATH 421
- MATH 456
- MATH 461
- MATH 467
- MATH 468
- MATH 479
- MATH 484
- MATH 485

Select 6 credits of the following:
- MATH 401
- MATH 405
- MATH 406
- MATH 441
- MATH 470
- MATH 471

Select 3 credits of the following:
- CMPSC 122 Intermediate Programming
- CMPSC 465 Data Structures and Algorithms

Supporting Courses and Related Areas
Select 17-18 credits from department list 17-18

Computational Mathematics Option (50-51 credits)
Available at the following campuses: University Park

Code Title Credits
Prescribed Courses
CMPSC 122 Intermediate Programming 3
CMPSC 465 Data Structures and Algorithms 3

Prescribed Courses: Require a grade of C or better
MATH 414 Introduction to Probability Theory 3
MATH 415 Introduction to Mathematical Statistics 3
MATH 455 Introduction to Numerical Analysis I 3
MATH 456 Introduction to Numerical Analysis II 3
MATH 467 Factorization and Primality Testing 3
MATH 484 Linear Programs and Related Problems 3

Additional Courses
Additional Courses: Require a grade of C or better
Select 3 credits of the following:
- MATH 411
- MATH 416
- MATH 417
- MATH 419
- MATH 421
- MATH 456
- MATH 467
- MATH 468
- MATH 479
- MATH 484
- MATH 485

Select 6 credits of the following:
- MATH 401
- MATH 405
- MATH 406
- MATH 441
- MATH 470
- MATH 471

Supporting Courses and Related Areas
Select 17-18 credits from department list 17-18

General Mathematics Option (50-51 credits)
Available at the following campuses: Altoona, University Park

Code Title Credits
Prescribed Courses
MATH 403 Classical Analysis I 3
MATH 414 Introduction to Probability Theory 3
MATH 415 Introduction to Mathematical Statistics 3

Additional Courses
Additional Courses: Require a grade of C or better
Select 12 credits of the following: 12

Select 3 credits of the following:
- MATH 411
- MATH 416
- MATH 417
- MATH 419
- MATH 421
- MATH 456
- MATH 467
- MATH 468
- MATH 479
- MATH 484
- MATH 485

Supporting Courses and Related Areas
Select 17-18 credits from department list 17-18
MATH 435  Basic Abstract Algebra  3
or MATH 436  Linear Algebra  3
Select 3 credits of the following:  3
   MATH 411  Ordinary Differential Equations
   MATH 412  Fourier Series and Partial Differential Equations
   MATH 417  Qualitative Theory of Differential Equations
   MATH 419  Theoretical Mechanics
   MATH 421  Complex Analysis
Select 6 credits of 400-level MATH courses \(^1\)  6

Supporting Courses and Related Areas
Select an approved sequence of 12 credits in MATH or a related area or an area of application  12
Select 17-18 credits from department list  17-18

\(^1\) Select 6 credits of 400-level MATH courses except:
   - MATH 401
   - MATH 405
   - MATH 406
   - MATH 441
   - MATH 470
   - MATH 471

Graduate Study Option (50-51 credits)
Available at the following campuses: University Park

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<td></td>
<td><em>Prescribed Courses: Require a grade of C or better</em></td>
<td></td>
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<tr>
<td>MATH 403</td>
<td>Classical Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 404</td>
<td>Classical Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 414</td>
<td>Introduction to Probability Theory</td>
<td>3</td>
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<tr>
<td>MATH 415</td>
<td>Introduction to Mathematical Statistics</td>
<td>3</td>
</tr>
<tr>
<td>MATH 421</td>
<td>Complex Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MATH 429</td>
<td>Introduction to Topology</td>
<td>3</td>
</tr>
<tr>
<td>MATH 435</td>
<td>Basic Abstract Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 436</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
</tbody>
</table>

|        | **Additional Courses**                     |         |
|        | *Additional Courses: Require a grade of C or better* |         |
|        | Select 9 credits of 400-level MATH courses \(^1\)  9  |         |

|        | **Supporting Courses and Related Areas**   |         |
|        | Select 17-18 credits from department list  | 17-18   |

\(^1\) Select 9 credits of 400-level MATH courses except:
   - MATH 401
   - MATH 405
   - MATH 406
   - MATH 441
   - MATH 470
   - MATH 471

Systems Analysis Option (50-51 credits)
Available at the following campuses: Altoona, University Park

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<td>MATH 436</td>
<td>Linear Algebra</td>
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<td>MATH 484</td>
<td>Linear Programs and Related Problems</td>
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|        | **Additional Courses**                     |         |
|        | *Additional Courses: Require a grade of C or better* |         |
|        | Select 6 credits of the following:         | 6       |
| MATH 310 | Elementary Combinatorics                   |         |
| MATH 451 | Numerical Computations                     |         |
| MATH 485 | Graph Theory                               |         |
| MATH 486 | Mathematical Theory of Games               |         |

|        | **Supporting Courses and Related Areas**   |         |
|        | Select 3 credits from 400-level MATH courses \(^1\)  3  |         |

|        | **Supporting Courses and Related Areas**   |         |
|        | Select an approved sequence of 12 credits in an area of application; possible areas include business, economics, industrial engineering, social sciences | 12 |
|        | Select 17-18 credits from department list  | 17-18   |

\(^1\) Select 3 credits of 400-level MATH courses except:
   - MATH 401
   - MATH 405
   - MATH 406
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