Mathematics

Dr. Janet McShane
Chair of the Department

The Department of Mathematics plays a vital role in the education of all students at Manhattan College through its offerings of programs for our majors as well as for the many support courses it offers for other departments across the college. We provide students the mathematical skills necessary to be successful in their field of study whether it is mathematics, science, engineering, business, education or the liberal arts.

The mathematics curriculum for our majors allows students to prepare for careers in business, industry, actuarial science and teaching as well as to prepare for the study of mathematics at the graduate level. Yearlong courses in Linear Algebra, Abstract Algebra, and Analysis prepare students for further work in pure or applied mathematics. A selection of courses from Linear Algebra, Probability, Statistics, and Operation Research form the basis for work in finance, engineering, and all of the sciences. Students may select from a variety of advanced topics offered by faculty with expertise in an area of pure or applied mathematics.

Our classes are small which gives students the opportunity to build strong relationships with faculty. Students are invited to participate in national mathematics competitions such as the Putnam Exam and the Mathematical Modeling Contest. Many students participate in undergraduate research projects; funds, both internally and externally, are available to support these projects during the summer. Students are encouraged to present their work at the Spuyten Duyvil Undergraduate Mathematics Conference, which was founded by the Mathematics Department at Manhattan College, as well as at other national and regional meetings.

Any student wishing to participate in the Study Abroad program will find the Department makes every effort to provide the needed support to allow them to finish their required course work.

The Department is a member of the national mathematics honor society, Pi Mu Epsilon, which is dedicated to the promotion of mathematics and recognition of students who successfully pursue mathematical understanding. Students are nominated for membership in this honor society. The Department also nominates students who make presentations at conferences for membership in Sigma Xi, an international honor society for science and engineering.

Degree Plans
The Department of Mathematics offers the following programs:

- Major in Mathematics
  - Bachelor of Science Degree
  - Bachelor of Arts Degree
- Second Major in Mathematics
- Concentration in Applied Mathematics
- Minor in Mathematics
Also, the Department works closely with the School of Education & Health on the requirements for the BS in Adolescence Education Mathematics which prepares students to teach at the secondary level and the Mathematics emphasis in the BS in Childhood Education which prepares students to teach at the elementary level. The requirements for the BS in Adolescence Education Mathematics are listed below under second major in mathematics.

**General Requirements**
Courses should be taken in accordance with the Plans of Study listed below. The order in which core courses are taken is flexible but care should be taken in planning your program since some courses are not offered every semester. A minimum grade of C is required in each of the courses used for any of the listed programs (major, second major, concentration, or minor).

**Major in Mathematics**

**BS in Mathematics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 185</td>
<td>Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 186</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 243</td>
<td>Discrete Foundations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 272</td>
<td>Linear Algebra I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 285</td>
<td>Calculus III</td>
<td>3</td>
</tr>
<tr>
<td>MATH 331</td>
<td>Probability</td>
<td>3</td>
</tr>
<tr>
<td>MATH 336</td>
<td>Applied Statistics</td>
<td>3</td>
</tr>
<tr>
<td>MATH 377</td>
<td>Algebra I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 387</td>
<td>Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 471</td>
<td>Linear Algebra II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 478</td>
<td>Algebra II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 489</td>
<td>Problem Seminar</td>
<td>3</td>
</tr>
<tr>
<td>MATH 490</td>
<td>Complex Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Math Electives</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>CMPT 101</td>
<td>Computer Science I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 158</td>
<td>Introduction to Mathematical Computation</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 101</td>
<td>Physics I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; PHYS 191</td>
<td>and Physics I Lab</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 102</td>
<td>Physics II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; PHYS 192</td>
<td>and Physics II Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>Natural Sciences</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Total Credits</td>
<td></td>
<td>67</td>
</tr>
</tbody>
</table>

* Students who major in mathematics and are selected for the honors sequence will be enrolled in the Honors sections of Calculus I, II, and III (MATH 187, 188, and 287).

**BA in Mathematics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 185</td>
<td>Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>MATH 186</td>
<td>Calculus II *</td>
<td>3</td>
</tr>
<tr>
<td>MATH 243</td>
<td>Discrete Foundations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 272</td>
<td>Linear Algebra I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 285</td>
<td>Calculus III *</td>
<td>3</td>
</tr>
<tr>
<td>MATH 331</td>
<td>Probability</td>
<td>3</td>
</tr>
<tr>
<td>MATH 336</td>
<td>Applied Statistics</td>
<td>3</td>
</tr>
<tr>
<td>MATH 377</td>
<td>Algebra I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 387</td>
<td>Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 471</td>
<td>Linear Algebra II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 478</td>
<td>Algebra II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 489</td>
<td>Problem Seminar</td>
<td>3</td>
</tr>
<tr>
<td>MATH 490</td>
<td>Complex Analysis</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Math Electives</td>
<td>6</td>
</tr>
<tr>
<td>CMPT 101</td>
<td>Computer Science I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 158</td>
<td>Introduction to Mathematical Computation</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>3 SCI Courses **</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Total Credits</td>
<td>60</td>
</tr>
</tbody>
</table>

* Students who major in mathematics and are selected for the honors sequence will be enrolled in the Honors sections of Calculus I, II, and III (MATH 187, 188, and 287).

** Students may opt for one full year of a lab science (8 credits). In this case, the student will graduate with 120 credits. Students may also opt to replace the 3 SCI XXX courses with 9 credits of courses within a single discipline in the School of Science.

Second Major in Mathematics

**Students from the Schools of Liberal Arts, Business, Engineering, and Science**

To complete a second major in Mathematics, students from the above Schools will need to take a total of 36 credits of mathematics courses from the mathematics major courses listed above. These credits must include MATH 185, 186, 243, 272, 377, and 387, and at least 2 courses at the 400 level.

**Students from the School of Education & Health**

Students pursuing a degree in Adolescence Education Mathematics earn a second major in mathematics by completing the following sequence as required by their degree program.

**BS in Adolescence Education Mathematics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 185</td>
<td>Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 186</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 243</td>
<td>Discrete Foundations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 272</td>
<td>Linear Algebra I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 285</td>
<td>Calculus III</td>
<td>3</td>
</tr>
<tr>
<td>MATH 331</td>
<td>Probability</td>
<td>3</td>
</tr>
<tr>
<td>Course</td>
<td>Title</td>
<td>Credits</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>MATH 336</td>
<td>Applied Statistics</td>
<td>3</td>
</tr>
<tr>
<td>MATH 361</td>
<td>Introduction to Higher Geometry</td>
<td>3</td>
</tr>
<tr>
<td>MATH 377</td>
<td>Algebra I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 387</td>
<td>Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 489</td>
<td>Problem Seminar</td>
<td>3</td>
</tr>
<tr>
<td>MATH 422</td>
<td>Seminar for Mathematics Education</td>
<td>3</td>
</tr>
<tr>
<td>CMPT 101</td>
<td>Computer Science I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 158</td>
<td>Introduction to Mathematical Computation</td>
<td>3</td>
</tr>
<tr>
<td>CMPT 214</td>
<td>Teaching and Learning with Technology</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Credits</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>

*Sequencing of courses is very important so that only one course (MATH 422) is required during the semester when the student is doing student teaching.*

### Concentration in Applied Mathematics

The 24 credit hour Concentration in Applied Mathematics is designed to complement major study in a different discipline, and prepare students to use mathematics in the workplace. The concentration offers more depth than the minor in Mathematics and is currently approved for students in most majors in the Schools of Arts, Business, Engineering, and Science.

The requirements are flexible. There is a 12 credit hour required core which includes Calculus I-II-III (MATH 185, 186, 285) and Linear Algebra (MATH 272). Students choose the remaining 12 credits from a list of approved courses, including Differential Equations (MATH 286), Probability (MATH 331), Partial Differential Equations (MATH 386), Vector Calculus (MATH 385), Statistical Inference (MATH 432), Machine Learning (MATH 457), Operations Research (MATH 455), Linear Algebra II (MATH 471), and Topics in Mathematics. Students must select at least one two-term sequence for depth.

Completion of the Concentration will be documented on the student's transcript.

### Minor in Mathematics

The minor in Mathematics consists of a minimum of 15 credits and must include a yearlong calculus sequence. The eligible courses vary depending on the student’s major.

Specific requirements are listed below. A grade of at least a C is required for all courses meeting the requirements for a minor in Mathematics.

Note: The following courses may not be used toward the Mathematics minor: MATH 100, 111, 151, 153, 158, 221, 222, 230, 320, 321, 322 and 422.

**Application:** To pursue the minor in Mathematics, a student must get a Minor Form from the department, fill it out, and have it signed by the Chair of the Department of Mathematics. An approved form will be forwarded to the appropriate dean.

### Minor Requirements for Students in the School of Science

The minor in Mathematics consists of a minimum of 15 credits including Calculus I (MATH 155 or 185), Calculus II (MATH 156 or 186), and Calculus III (MATH 285). The remaining courses should be chosen from the list of courses required for the mathematics
major, and selected 300-400 level courses, including Topics courses, with approval of the Department Chair.

**Minor Requirements for Students in the School of Engineering**
The minor in Mathematics consists of a minimum of 15 credits including MATH 185, 186, 285, and 286. The remaining course(s) can be chosen from the following: MATH 243, 272, 331 (not approved for EECE and CE), 385 (not approved for EECE), 386, 432 (not approved for EECE or CE), 455, 490 (recommended for EECE), selected 300-400 level courses, including Topics courses, with approval of the Department Chair.

**Minor Requirements for Students in the School of Liberal Arts or School of Business**
The minor in mathematics consists of a minimum of 15 credits including Calculus I (MATH 154 or 155 or 185) and Calculus II (MATH 156 or 186). The remaining courses can be chosen from the following: MATH 243, 272, 285, 286, 331, 385, 386, 432, 455, 490, and selected 300-400 level courses, including Topics courses, with approval of the Department Chair.

**BS in Childhood Education - Mathematics Plans**
All students majoring in Childhood Education take the following 6 credit core sequence.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 221</td>
<td>3</td>
</tr>
<tr>
<td>MATH 222</td>
<td>3</td>
</tr>
</tbody>
</table>

In addition, students majoring in Childhood Education may choose to do either a Concentration in Mathematics or an Emphasis in Mathematics as detailed below.

**BS in Childhood Education – Mathematics Concentration**
Childhood Education majors may choose to concentrate in Mathematics. These students take 30 credits in Mathematics including MATH 185, MATH 186, MATH 243, MATH 272, MATH 285, MATH 331, MATH 361, MATH 422, MATH 432 plus one additional elective approved by the Mathematics Department.

**BS in Childhood Education – General Studies Concentration with Mathematics**
Childhood Education majors may choose a General Studies Concentration with Mathematics as one area. These students take 15 credits in Mathematics. Please see the Department of Mathematics or the Department of Education for the requirements for this option.

**PLAN OF STUDY**

**Bachelor of Science in Mathematics**

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MATH 185</td>
<td>3</td>
<td>MATH 186</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CMPT 101</td>
<td>3</td>
<td>MATH 158</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MFL*</td>
<td>3</td>
<td>MFL*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ENGL 110</td>
<td>3</td>
<td>RELS 110</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>LLRN 102</td>
<td>3</td>
<td>Social Science</td>
<td>3</td>
</tr>
</tbody>
</table>
### Second Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 285</td>
<td>3</td>
<td>MATH 272</td>
<td>3</td>
</tr>
<tr>
<td>MATH 243</td>
<td>3</td>
<td>MATH 336</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 101</td>
<td>4</td>
<td>PHYS 102</td>
<td>4</td>
</tr>
<tr>
<td>&amp; PHYS 191</td>
<td></td>
<td>&amp; PHYS 192</td>
<td></td>
</tr>
<tr>
<td>PHIL 150</td>
<td>3</td>
<td>ENGL 150</td>
<td>3</td>
</tr>
<tr>
<td>Social Science</td>
<td>3</td>
<td>Free Elective</td>
<td>3</td>
</tr>
<tr>
<td><strong>16</strong></td>
<td></td>
<td><strong>15</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Third Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 331***</td>
<td>3</td>
<td>MATH 387</td>
<td>3</td>
</tr>
<tr>
<td>MATH 377</td>
<td>3</td>
<td>MATH 478</td>
<td>3</td>
</tr>
<tr>
<td>MATH 471</td>
<td>3</td>
<td>RELS 2XX Catholic Studies</td>
<td>3</td>
</tr>
<tr>
<td>Natural Science**</td>
<td>4</td>
<td>Natural Science**</td>
<td>4</td>
</tr>
<tr>
<td>HIST 150</td>
<td>3</td>
<td>MUSC 150 or ART 150</td>
<td>3</td>
</tr>
<tr>
<td><strong>16</strong></td>
<td></td>
<td><strong>16</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Fourth Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 489</td>
<td>3</td>
<td>MATH 490</td>
<td>3</td>
</tr>
<tr>
<td>MATH Elective</td>
<td>3</td>
<td>MATH Elective</td>
<td>3</td>
</tr>
<tr>
<td>Free Electives</td>
<td>9</td>
<td>Free Electives</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RELS 3XX Global/Contemporary</td>
<td>3</td>
</tr>
<tr>
<td><strong>15</strong></td>
<td></td>
<td><strong>15</strong></td>
<td></td>
</tr>
</tbody>
</table>

Total Credits: 125

* One year sequence of a Modern Foreign Language.

** One year (8 credits with lab) of the same natural science is required.

*** If MATH 432 Statistical Inference is taken as a Math elective, it is recommended it be taken immediately following MATH 331 Probability.

### Bachelor of Arts in Mathematics

### First Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 185</td>
<td>3</td>
<td>MATH 186</td>
<td>3</td>
</tr>
<tr>
<td>CMPT 101</td>
<td>3</td>
<td>MATH 158</td>
<td>3</td>
</tr>
<tr>
<td>MFL*</td>
<td>3</td>
<td>MFL*</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 110</td>
<td>3</td>
<td>RELS 110</td>
<td>3</td>
</tr>
<tr>
<td>LLRN 102</td>
<td>3</td>
<td>Social Science</td>
<td>3</td>
</tr>
</tbody>
</table>
### Second Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 285</td>
<td>3</td>
<td>MATH 272</td>
<td>3</td>
</tr>
<tr>
<td>MATH 243</td>
<td>3</td>
<td>MATH 336</td>
<td>3</td>
</tr>
<tr>
<td>SCI XXX**</td>
<td>3</td>
<td>SCI XXX</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 150</td>
<td>3</td>
<td>SCI XXX</td>
<td>3</td>
</tr>
<tr>
<td>Social Science</td>
<td>3 ENGL 150</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Third Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 331***</td>
<td>3</td>
<td>MATH 387</td>
<td>3</td>
</tr>
<tr>
<td>MATH 377</td>
<td>3</td>
<td>MATH 478</td>
<td>3</td>
</tr>
<tr>
<td>MATH 471</td>
<td>3</td>
<td>RELS 2XX Catholic Studies</td>
<td>3</td>
</tr>
<tr>
<td>HIST 150</td>
<td>3</td>
<td>MUSC 150 or ART 150</td>
<td>3</td>
</tr>
<tr>
<td>Free Elective</td>
<td>3 Free Elective</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Fourth Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 489</td>
<td>3</td>
<td>MATH 490</td>
<td>3</td>
</tr>
<tr>
<td>MATH Elective</td>
<td>3 MATH Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Free Electives</td>
<td>9 RELS 3XX Global/Contemporary</td>
<td>3 Free Electives</td>
<td>6</td>
</tr>
</tbody>
</table>

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Credits: 121

* One year sequence of a Modern Foreign Language.

** Students may opt for one full year of a lab science (8 credits). In this case, the student will graduate with 120 credits. Students may also opt to replace SCI XXX with 9 credits of courses from within a single discipline in the School of Science.

*** If MATH 432 Statistical Inference is taken as a Math elective, it is recommended it be taken immediately following MATH 331 Probability.