**MATHEMATICS**

332G Milbank Hall  
212-854-3577  
Department Assistant: Marsha Peruo

**General Information**

Students who have special placement problems, or are unclear about their level, should make an appointment with a faculty member or the chair.

Two help rooms, one in 404 Mathematics and one in 333 Milbank, will be open all term (hours will be posted on the door and the online) for students seeking individual help and counseling from the instructors and teaching assistants. No appointments are necessary. However, resources are limited and students who seek individual attention should make every effort to come during the less popular hours and to avoid the periods just before midterm and final exams.

**Courses for First-Year Students**

The systematic study of Mathematics begins with one of the following alternative sequences:

<table>
<thead>
<tr>
<th>Calculus I, II, III, IV</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH UN1101</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MATH UN1102</td>
<td>Calculus II</td>
</tr>
<tr>
<td>MATH UN1201</td>
<td>Calculus III</td>
</tr>
<tr>
<td>MATH UN1202</td>
<td>Calculus IV</td>
</tr>
<tr>
<td><strong>Honors Math A-B</strong></td>
<td></td>
</tr>
<tr>
<td>MATH UN1207</td>
<td>Honors Mathematics A</td>
</tr>
<tr>
<td>MATH UN1208</td>
<td>Honors Mathematics B</td>
</tr>
</tbody>
</table>

Credit is allowed for only one of the calculus sequences. The calculus sequence is a standard course in differential and integral calculus. **Honors Mathematics A-B** is for exceptionally well-qualified students who have strong advanced placement scores. It covers second-year Calculus (MATH UN1201 Calculus III—MATH UN1202 Calculus IV) and MATH UN2010 Linear Algebra, with an emphasis on theory.

**Calculus II** is NOT a prerequisite for **Calculus III**, so students who plan to take only one year of calculus may choose between I and II or I and III. The latter requires a B or better in Calculus I and is a recommended option for some majors.

MATH UN2000 An Introduction to Higher Mathematics is a course that can be taken in their first or second year by students with an aptitude for mathematics who would like to practice writing and understanding mathematical proofs.

**Placement in the Calculus Sequence**

**College Algebra and Analytical Geometry** is a refresher course for students who intend to take Calculus but do not have adequate background for it.

**Advanced Placement:** Students who have passed the advanced placement test for Calculus AB with a grade of 4 or 5 or BC with a grade of 4 receive 3 points of credit. Those who passed Calculus BC with a grade of 5 will receive 4 points of credit or 6 points on placing into Calculus III or Honors Math A and completing with a grade of C or better.

Calculus I, II, III: Students who have not previously studied calculus should begin with Calculus I. Students with 4 or higher on the Calculus AB or BC advanced placement test may start with Calculus II. Students with 5 on the Calculus BC test should start with Calculus III.

**Honors Mathematics A:** Students who have passed the Calculus BC advanced placement test with a grade of 5, and who have strong mathematical talent and motivation, should start with Honors Mathematics A. This is the most attractive course available to well-prepared, mathematically talented first-year students, whether or not they intend to be mathematics majors. Students who contemplate taking this course should consult with the instructor. If this is not possible ahead of time, they should register and attend the first class.

**Chair:** Daniela De Silva (Associate Professor)  
**Professors:** Dave Bayer, Dusa McDuff (Helen Lyttle Kimmel Chair), Walter D. Neumann  
**Associate Professor:** Daniela De Silva  
**Research Professor and Professor Emerita:** Joan Birman

Links to other faculty of Columbia University offering courses in Mathematics:

Faculty by Rank: [http://www.math.columbia.edu/people/faculty-by-rank/](http://www.math.columbia.edu/people/faculty-by-rank/)


**Requirements for the Major**

The major programs in both Mathematics and Applied Mathematics are appropriate for students who plan to continue their training in graduate school. The major in Mathematical Sciences combines the elements of Mathematics, Computer Science and Statistics. It is designed to prepare students for employment in business, administration, and finance, and also give excellent background for someone planning graduate study in a social science field. Students who plan to obtain a teaching qualification in mathematics should plan their course of study carefully with an advisor, since courses that are too far from mathematics do not count towards certification.

**For a major in Mathematics: 14 courses as follows:**

Four courses in calculus or Honors Mathematics A-B, including Advanced Placement Credit. Six courses in mathematics numbered at or above 2000, and four courses in any combination of mathematics and cognate courses. The courses in mathematics must include:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH UN2010</td>
<td>Linear Algebra (also satisfied by Honors Math A-B)</td>
</tr>
<tr>
<td>MATH GU4041</td>
<td>INTRO MODERN ALGEBRA I (I)</td>
</tr>
<tr>
<td>MATH GU4042</td>
<td>INTRO MODERN ALGEBRA II (II)</td>
</tr>
<tr>
<td>MATH GU4061</td>
<td>INTRO MODERN ANALYSIS I (I)</td>
</tr>
<tr>
<td>MATH GU4062</td>
<td>Introduction To Modern Analysis II (II)</td>
</tr>
<tr>
<td>MATH UN3951</td>
<td>Undergraduate Seminars in Mathematics (I at least one term)</td>
</tr>
<tr>
<td>or MATH UN3952</td>
<td>Undergraduate Seminars in Mathematics II</td>
</tr>
</tbody>
</table>

*Note: It is strongly recommended that the sequences MATH GU4041 INTRO MODERN ALGEBRA I - MATH GU4062 Introduction To Modern Analysis II and MATH GU4061 INTRO MODERN ANALYSIS I - MATH GU4062 Introduction To Modern Analysis II be taken in separate years.*
However, students who are not contemplating graduate study in mathematics may replace one or both of the two terms of MATH GU4061 INTRO MODERN ANALYSIS I · MATH GU4062 Introduction To Modern Analysis II by one or two of the following courses: MATH UN2500 Analysis and Optimization, MATH UN3007 Complex Variables, or MATH GU4032 Fourier Analysis and may replace MATH GU4042 INTRO MODERN ALGEBRA II by one of MATH UN3020 Number Theory and Cryptography or MATH UN3025 Making, Breaking Codes. In exceptional cases, the chair will approve the substitution of certain more advanced advanced courses for those mentioned above.

**For a major in Applied Mathematics: 14 courses**

Four courses in calculus or Honors Mathematics A-B, including Advanced Placement Credit.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH UN2010</td>
<td>Linear Algebra (also satisfied by Honors Math A-B)</td>
</tr>
<tr>
<td>MATH GU4061</td>
<td>INTRO MODERN ANALYSIS I</td>
</tr>
<tr>
<td>APMA E4901</td>
<td>Seminar: Problem in Applied Mathematics</td>
</tr>
<tr>
<td>APMA E4903</td>
<td>Seminar: Problems in Applied Mathematics</td>
</tr>
<tr>
<td>APMA E3900</td>
<td>Undergraduate Research in Applied Mathematics (APMA E3900 may be replaced, with approval, by another technical elective for seniors that involves an undergraduate thesis or creative research report)</td>
</tr>
</tbody>
</table>

Additional electives, to be approved by the Applied Math Committee, e.g.:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH UN2500</td>
<td>Analysis and Optimization</td>
</tr>
<tr>
<td>MATH UN3007</td>
<td>Complex Variables</td>
</tr>
<tr>
<td>or MATH GU4065</td>
<td>Honors Complex Variables</td>
</tr>
<tr>
<td>or APMA E4204</td>
<td>Functions of a Complex Variable</td>
</tr>
<tr>
<td>MATH UN3027</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>or MATH UN2030</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>MATH UN3028</td>
<td>Partial Differential Equations</td>
</tr>
<tr>
<td>or APMA E4200</td>
<td>Partial Differential Equations</td>
</tr>
<tr>
<td>MATH GU4032</td>
<td>Fourier Analysis</td>
</tr>
<tr>
<td>APMA E4300</td>
<td>Computational Math: Introduction to Numerical Methods</td>
</tr>
<tr>
<td>APMA E4101</td>
<td>Introduction to Dynamical Systems</td>
</tr>
<tr>
<td>APMA E4150</td>
<td>Applied Functional Analysis</td>
</tr>
</tbody>
</table>

More generally, electives may be any course with a prerequisite of at least one semester of Calculus, Statistics or Computer Science with the prior approval of the Mathematics Chair.

The Capstone Experience can be fulfilled by a significant thesis written under the supervision of faculty of any one of the three departments or by the Undergraduate Seminar in Mathematics.

**For a major in Mathematical Sciences: 14 courses:**

6 from Mathematics, 5 from a combination of Statistics and Computer Science and 3 electives from a combination of Mathematics, Statistics, Computer Science.

### Mathematics

Six required courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH UN1101</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MATH UN1102</td>
<td>Calculus II</td>
</tr>
<tr>
<td>MATH UN1201</td>
<td>Calculus III</td>
</tr>
<tr>
<td>MATH UN2010</td>
<td>Linear Algebra (also satisfied by Honors Math A-B)</td>
</tr>
<tr>
<td>MATH UN2000</td>
<td>An Introduction to Higher Mathematics</td>
</tr>
<tr>
<td>MATH UN2030</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>or MATH UN3027</td>
<td>Ordinary Differential Equations</td>
</tr>
</tbody>
</table>

### Statistics

Statistics required courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT UN1201</td>
<td>Calculus-Based Introduction to Statistics</td>
</tr>
<tr>
<td>STAT GU4203</td>
<td>PROBABILITY THEORY</td>
</tr>
<tr>
<td>STAT GU4204</td>
<td>Statistical Inference</td>
</tr>
<tr>
<td>STAT GU4205</td>
<td>Linear Regression Models</td>
</tr>
</tbody>
</table>

And select one of the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT GU4207</td>
<td>Elementary Stochastic Processes</td>
</tr>
<tr>
<td>STAT GU4262</td>
<td>Stochastic Processes for Finance</td>
</tr>
<tr>
<td>STAT GU4264</td>
<td>STOCHASTIC PROCESSES-APPLIC</td>
</tr>
<tr>
<td>STAT GU4265</td>
<td>Stochastic Methods in Finance</td>
</tr>
</tbody>
</table>

### Computer Science

Select one of the following sequences:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH UN1101</td>
<td>Calculus I</td>
</tr>
<tr>
<td>- MATH UN1102</td>
<td>and Calculus II</td>
</tr>
<tr>
<td>- MATH UN1201</td>
<td>and Calculus III</td>
</tr>
<tr>
<td>- MATH UN2010</td>
<td>and Linear Algebra</td>
</tr>
<tr>
<td>- MATH UN2500</td>
<td>and Analysis and Optimization</td>
</tr>
<tr>
<td>MATH UN1207</td>
<td>Honors Mathematics A</td>
</tr>
<tr>
<td>- MATH UN1208</td>
<td>and Honors Mathematics B</td>
</tr>
<tr>
<td>- MATH UN2500</td>
<td>and Analysis and Optimization</td>
</tr>
</tbody>
</table>
Select one of the following courses:

COMS W1004  Introduction to Computer Science and Programming in Java
COMS W1005  Introduction to Computer Science and Programming in MATLAB
COMS W1007  Honors Introduction to Computer Science
ENGI E1006  Introduction to Computing for Engineers and Applied Scientists
or an advanced Computer Science offering in programming

Electives
An approved selection of three advanced courses in mathematics, statistics, applied mathematics, industrial engineering and operations research, computer science, or approved mathematical methods courses in a quantitative discipline. At least one elective must be a Mathematics Department course numbered 3000 or above.

Students should plan to include a senior thesis or the Undergraduate Seminar in Mathematics in their program, in consultation with their advisors.

Note: Students must obtain approval from an adviser in each of the two departments before selecting electives. Students should take MATH UN2010 Linear Algebra in the second semester of the second year.

For a major in Mathematics-Computer Science 15 courses:

Mathematics
Four courses in calculus or Honors Mathematics A-B, including Advanced Placement Credit; and the 3 following courses:

MATH UN2010  Linear Algebra (also satisfied by Honors Math A-B)
MATH GU4041  INTRO MODERN ALGEBRA I
MATH UN3951  Undergraduate Seminars in Mathematics I (at least one term)
or MATH UN3952  Undergraduate Seminars in Mathematics II

Computer Science
COMS W1004  Introduction to Computer Science and Programming in Java
COMS W3134  Data Structures in Java
COMS W3157  Advanced Programming
COMS W3203  Discrete Mathematics: Introduction to Combinatorics and Graph Theory
COMS W3261  Computer Science Theory
CSEE W3827  Fundamentals of Computer Systems

Note: AP Computer Science with a grade of 4 or 5 or similar experience (e.g., COMS W1004) is a prerequisite for COMS W1007

Students seeking to pursue a Ph.D. program in either discipline are urged to take additional courses, in consultation with their advisers.

For a major in Economics and Mathematics, see the catalogue.

Requirement for the Minor in Mathematics
For a minor in Mathematics or Applied Mathematics: Six courses from any of the courses offered by the department except MATH UN1003 College Algebra and Analytic Geometry, MATH UN1101 Calculus I / MATH UN1102 Calculus II. Some cognate courses are also acceptable with prior approval from the department chair.

Requirements for the Minor in Mathematical Sciences
The minor in Mathematical Sciences comprises 6 courses, at least two from Mathematics and one from each of Statistics and Computer Science. There should be a minimum of three courses in Statistics and Computer Science. Eligible courses are any listed in the Mathematical Sciences Major with the exception of Calculus I and II.

MATH UN1003 College Algebra and Analytic Geometry. 3 points.
Prerequisites: score of 550 on the mathematics portion of the SAT completed within the last year or the appropriate grade on the General Studies Mathematics Placement Examination.
Columbia College students do not receive any credit for this course and must see their CSA advising dean. For students who wish to study calculus but do not know analytic geometry. Algebra review, graphs and functions, polynomial functions, rational functions, conic sections, systems of equations in two variables, exponential and logarithmic functions, trigonometric functions and trigonometric identities, applications of trigonometry, sequences, series, and limits.

Spring 2020: MATH UN1003

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1003</td>
<td>002/12023</td>
<td>T Th 11:40am - 12:55pm</td>
<td>Yier Lin</td>
<td>3</td>
<td>10/30</td>
</tr>
<tr>
<td>MATH 1003</td>
<td>003/00593</td>
<td>M W 6:10pm - 7:25pm</td>
<td>Lindsay Piechnik</td>
<td>3</td>
<td>26/36</td>
</tr>
</tbody>
</table>

Fall 2020: MATH UN1003

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1003</td>
<td>001/11290</td>
<td>M W 6:10pm - 7:25pm</td>
<td>Alexander Pieloch</td>
<td>3</td>
<td>3/30</td>
</tr>
<tr>
<td>MATH 1003</td>
<td>002/11291</td>
<td>T Th 2:40pm - 3:55pm</td>
<td>Mrudul Thatte</td>
<td>3</td>
<td>4/30</td>
</tr>
</tbody>
</table>

Electives: 2 of the following:

CSOR W4231  Analysis of Algorithms I
COMS W4241  Numerical Algorithms and Complexity
MATH UN3020  Number Theory and Cryptography
MATH BC2006  Combinatorics
MATH GU4061  INTRO MODERN ANALYSIS I
MATH UN2500  Analysis and Optimization
MATH UN3007  Complex Variables
MATH UN3386  Differential Geometry
MATH GU4051  Topology
MATH UN1101 Calculus I. 3 points.  
Prerequisites: (see Courses for First-Year Students). Functions, limits, derivatives, introduction to integrals, or an understanding of pre-calculus will be assumed.

The Help Room in 333 Milbank Hall (Barnard College) is open during the day, Monday through Friday, to students seeking individual help from the teaching assistants. (SC)

Spring 2020: MATH UN1101

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1101</td>
<td>001/13846</td>
<td>M W 11:40am - 12:55pm 407 Mathematics Building</td>
<td>Cailan Li</td>
<td>3</td>
<td>20/30</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>002/12024</td>
<td>M W 2:40pm - 3:55pm 203 Mathematics Building</td>
<td>Akash Sengupta</td>
<td>3</td>
<td>72/110</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>003/12025</td>
<td>M W 6:10pm - 7:25pm 407 Mathematics Building</td>
<td>Gerhardt Hinkle</td>
<td>3</td>
<td>20/30</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>004/12026</td>
<td>T Th 10:10am - 11:25am 203 Mathematics Building</td>
<td>Alexandra Florea</td>
<td>3</td>
<td>85/110</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>005/12027</td>
<td>T Th 11:40am - 12:55pm 203 Mathematics Building</td>
<td>William Chen</td>
<td>3</td>
<td>44/110</td>
</tr>
</tbody>
</table>

Fall 2020: MATH UN1101

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1101</td>
<td>002/11292</td>
<td>M W 10:10am - 11:25am Room TBA</td>
<td>Daniele Alessandrini</td>
<td>3</td>
<td>10/116</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>003/11293</td>
<td>M W 11:40am - 12:55pm Room TBA</td>
<td>Daniele Alessandrini</td>
<td>3</td>
<td>3/116</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>004/11294</td>
<td>M W 1:10pm - 2:25pm Room TBA</td>
<td>Akash Sengupta</td>
<td>3</td>
<td>8/110</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>005/11295</td>
<td>M W 2:40pm - 3:55pm Room TBA</td>
<td>Akash Sengupta</td>
<td>3</td>
<td>13/110</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>006/11296</td>
<td>M W 4:10pm - 5:25pm Room TBA</td>
<td>Chung Hang Kwok</td>
<td>3</td>
<td>3/30</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>007/11297</td>
<td>T Th 10:10am - 11:25am Room TBA</td>
<td>George Dragomir</td>
<td>3</td>
<td>14/100</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>008/11298</td>
<td>T Th 11:40am - 12:55pm Room TBA</td>
<td>Robin Zhang</td>
<td>3</td>
<td>14/30</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>009/11299</td>
<td>T Th 1:10pm - 2:25pm Room TBA</td>
<td>George Dragomir</td>
<td>3</td>
<td>6/100</td>
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<tr>
<td>MATH 1101</td>
<td>010/11300</td>
<td>T Th 4:10pm - 5:25pm Room TBA</td>
<td>3</td>
<td>2/100</td>
<td></td>
</tr>
</tbody>
</table>

MATH UN1102 Calculus II. 3 points.  
Prerequisites: MATH UN1101 or the equivalent. Methods of integration, applications of the integral, Taylor's theorem, infinite series. (SC)

Spring 2020: MATH UN1102

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1102</td>
<td>001/12029</td>
<td>M W 1:10pm - 2:25pm 207 Mathematics Building</td>
<td>Yi Sun</td>
<td>3</td>
<td>43/125</td>
</tr>
<tr>
<td>MATH 1102</td>
<td>002/12030</td>
<td>M W 2:40pm - 3:55pm 407 Mathematics Building</td>
<td>Semen Rezchikov</td>
<td>3</td>
<td>32/35</td>
</tr>
<tr>
<td>MATH 1102</td>
<td>003/12031</td>
<td>T Th 11:40am - 12:55pm 207 Mathematics Building</td>
<td>Michael Woodbury</td>
<td>3</td>
<td>51/125</td>
</tr>
<tr>
<td>MATH 1102</td>
<td>004/12032</td>
<td>T Th 6:10pm - 7:25pm 407 Mathematics Building</td>
<td>Iakov Kononenko</td>
<td>3</td>
<td>18/30</td>
</tr>
</tbody>
</table>

Fall 2020: MATH UN1102

<table>
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<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1102</td>
<td>001/11302</td>
<td>M W 11:40am - 12:55pm Room TBA</td>
<td>Maithreya Sitaraman</td>
<td>3</td>
<td>9/30</td>
</tr>
<tr>
<td>MATH 1102</td>
<td>002/11303</td>
<td>M W 2:40pm - 3:55pm Room TBA</td>
<td>Renata Picciotto</td>
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<td>14/30</td>
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<tr>
<td>MATH 1102</td>
<td>003/11304</td>
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<td>1/110</td>
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</tr>
<tr>
<td>MATH 1102</td>
<td>004/11305</td>
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<td>8/110</td>
<td></td>
</tr>
<tr>
<td>MATH 1102</td>
<td>005/00434</td>
<td>T Th 2:40pm - 3:55pm Room TBA</td>
<td>Lindsay Piechnik</td>
<td>3</td>
<td>33/100</td>
</tr>
<tr>
<td>MATH 1102</td>
<td>006/11306</td>
<td>T Th 6:10pm - 7:25pm Room TBA</td>
<td>Elliott Stein</td>
<td>3</td>
<td>18/45</td>
</tr>
</tbody>
</table>
MATH UN1201 Calculus III. 3 points.
Prerequisites: MATH UN101 or the equivalent
Vectors in dimensions 2 and 3, complex numbers and the complex exponential function with applications to differential equations, Cramer's rule, vector-valued functions of one variable, scalar-valued functions of several variables, partial derivatives, gradients, surfaces, optimization, the method of Lagrange multipliers. (SC)

<table>
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<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1201</td>
<td>001/12037</td>
<td>M W 10:10am - 11:25am 207 Mathematics Building</td>
<td>Carolyn Abbott</td>
<td>3</td>
<td>45/125</td>
</tr>
<tr>
<td>MATH 1201</td>
<td>002/12039</td>
<td>M W 11:40am - 12:55pm 602 Hamilton Hall</td>
<td>Konstantin</td>
<td>3</td>
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<tr>
<td>MATH 1201</td>
<td>003/12040</td>
<td>M W 2:40pm - 3:55pm 312 Mathematics Building</td>
<td>Igor Krichever</td>
<td>3</td>
<td>99/120</td>
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<tr>
<td>MATH 1201</td>
<td>004/12041</td>
<td>T Th 1:10pm - 2:25pm 312 Mathematics Building</td>
<td>Stephen Miller</td>
<td>3</td>
<td>87/116</td>
</tr>
<tr>
<td>MATH 1201</td>
<td>005/12042</td>
<td>T Th 6:10pm - 7:25pm 207 Mathematics Building</td>
<td>Inbar Klang</td>
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Fall 2020: MATH UN1201

<table>
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<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
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<tr>
<td>MATH 1201</td>
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<td>Ovidiu Savin</td>
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<td>MATH 1201</td>
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<td>Evan Warner</td>
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<td>Inbar Klang</td>
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<tr>
<td>MATH 1201</td>
<td>008/11417</td>
<td>T Th 6:10pm - 7:25pm Room TBA</td>
<td>Guillaume Remy</td>
<td>3</td>
<td>3/116</td>
</tr>
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</table>

Mathematics UN1202 Calculus IV. 3 points.
Prerequisites: MATH UN102 and MATH UN1201 or the equivalent
Multiple integrals, Taylor’s formula in several variables, line and surface integrals, calculus of vector fields, Fourier series. (SC)

Spring 2020: MATH UN1202

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>MATH 1202</td>
<td>001/00067</td>
<td>T Th 10:10am - 11:25am 202 Milbank Hall</td>
<td>Daniela De Silva</td>
<td>3</td>
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</tr>
<tr>
<td>MATH 1202</td>
<td>002/00275</td>
<td>T Th 2:40pm - 3:55pm 202 Milbank Hall</td>
<td>Lindsay Piekarcz</td>
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Fall 2020: MATH UN1202

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<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>MATH 1202</td>
<td>001/11421</td>
<td>T Th 10:10am - 11:25am Room TBA</td>
<td>Stephen Miller</td>
<td>3</td>
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<tr>
<td>MATH 1202</td>
<td>002/11424</td>
<td>M W 6:10pm - 7:25pm Room TBA</td>
<td>Mikhail Smirnov</td>
<td>3</td>
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</table>

MATH UN1207 Honors Mathematics A. 4 points.
Prerequisites: (see Courses for First-Year Students). The second term of this course may not be taken without the first. Multivariable calculus and linear algebra from a rigorous point of view. Recommended for mathematics majors. Fulfills the linear algebra requirement for the major. (SC)

Fall 2020: MATH UN1207

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>MATH 1207</td>
<td>001/11430</td>
<td>T Th 1:10pm - 2:25pm Room TBA</td>
<td>Evan Warner</td>
<td>4</td>
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MATH UN1208 Honors Mathematics B. 4 points.
Prerequisites: (see Courses for First-Year Students).
The second term of this course may not be taken without the first. Multivariable calculus and linear algebra from a rigorous point of view. Recommended for mathematics majors. Fulfills the linear algebra requirement for the major. (SC)

Spring 2020: MATH UN1208

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tbody>
<tr>
<td>MATH 1208</td>
<td>001/12047</td>
<td>M W 4:10pm - 5:25pm 312 Mathematics Building</td>
<td>Evan Warner</td>
<td>4</td>
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MATH UN2000 An Introduction to Higher Mathematics. 3 points.
Introduction to understanding and writing mathematical proofs. Emphasis on precise thinking and the presentation of mathematical results, both in oral and in written form. Intended for students who are considering majoring in mathematics but wish additional training. CC/ GS: Partial Fulfillment of Science Requirement. BC: Fulfillment of General Education Requirement: Quantitative and Deductive Reasoning (QUA).

Spring 2020: MATH UN2000

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>MATH 2000</td>
<td>001/00068</td>
<td>M W 2:40pm - 3:55pm 805 Altshul Hall</td>
<td>Dusa McDuff</td>
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Fall 2020: MATH UN2000

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<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>MATH 2000</td>
<td>001/11446</td>
<td>M W 11:40am - 12:55pm Room TBA</td>
<td>Gus Schrader</td>
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<td>19/49</td>
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MATH BC2001 Perspectives in Mathematics. 1 point.
Prerequisites: some calculus or the instructor’s permission.
Intended as an enrichment to the mathematics curriculum of the first years, this course introduces a variety of mathematical topics (such as three dimensional geometry, probability, number theory) that are often not discussed until later, and explains some current applications of mathematics in the sciences, technology and economics.

Fall 2020: MATH BC2001

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
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<td>MATH 2001</td>
<td>001/00116</td>
<td>T 6:10pm - 7:25pm Room TBA</td>
<td>Dusa McDuff</td>
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MATH BC2006 Combinatorics. 3 points.
Corequisites: MATH V2010 is helpful as a corequisite, but not required.
MATH UN2030 Ordinary Differential Equations. 3 points.
Prerequisites: MATH UN1102 and MATH UN1201 or the equivalent.

Spring 2020: MATH UN2030
Course Number Section/Call Number Times/Location Instructor Points Enrollment
MATH 2030 001/12103 T Th 4:10pm - 5:25pm 312 Mathematics Building Kyler Siegel 3 96/116
MATH 2030 002/12104 T Th 6:10pm - 7:25pm 312 Mathematics Building Kyler Siegel 3 37/116

Fall 2020: MATH UN2030
Course Number Section/Call Number Times/Location Instructor Points Enrollment
MATH 2030 001/11457 M W 11:10am - 2:25pm Room TBA Florian Johne 3 53/116
MATH 2030 002/11461 M W 2:40pm - 3:55pm Room TBA Florian Johne 3 33/116

MATH V2020 Honors Linear Algebra. 3 points.
CC/GS: Partial Fulfillment of Science Requirement
Not offered during 2019-20 academic year.

Prerequisites: MATH V1201.
A more extensive treatment of the material in Math V2010, with increased emphasis on proof. Not to be taken in addition to Math V2010 or Math V1207-Math V1208.

MATH UN3025 Making, Breaking Codes. 3 points.
Prerequisites: (MATH UN1101 and MATH UN1102) and MATH UN2010.
A concrete introduction to abstract algebra. Topics in abstract algebra used in cryptography and coding theory.

Spring 2020: MATH UN3025
Course Number Section/Call Number Times/Location Instructor Points Enrollment
MATH 3025 001/11471 T Th 1:10pm - 2:25pm Room TBA Dorian Goldfeld 3 74/116

MATH UN2500 Analysis and Optimization. 3 points.
Prerequisites: MATH UN1102 and MATH UN1201 or the equivalent and MATH UN2010.

Spring 2020: MATH UN2500
Course Number Section/Call Number Times/Location Instructor Points Enrollment
MATH 2500 001/12105 M W 1:10pm - 2:25pm 312 Mathematics Building Kanstantsin Matetski 3 29/110
MATH 2500 002/12107 M W 4:10pm - 5:25pm 207 Mathematics Building Kanstantsin Matetski 3 43/125

Fall 2020: MATH UN2500
Course Number Section/Call Number Times/Location Instructor Points Enrollment
MATH 2500 001/11464 T Th 1:10pm - 2:25pm Room TBA Kanstantsin Matetski 3 42/64
MATH 2500 002/11466 T 2:40pm - 3:55pm Room TBA Kanstantsin Matetski 3 39/64

MATH UN3007 Complex Variables. 3 points.
Prerequisites: MATH UN1202.
An elementary course in functions of a complex variable.
Fundamental properties of the complex numbers, differentiability, Cauchy-Riemann equations. Cauchy integral theorem. Taylor and Laurent series, poles, and essential singularities. Residue theorem and conformal mapping. (SC)

Fall 2020: MATH UN3007
Course Number Section/Call Number Times/Location Instructor Points Enrollment
MATH 3007 001/11470 M W 2:40pm - 3:55pm Room TBA Nicholas Salter 3 64/64

MATH UN3020 Number Theory and Cryptography. 3 points.
Prerequisites: one year of calculus. 
Prerequisite: One year of Calculus. Congruences. Primitive roots. Quadratic residues. Contemporary applications.

Spring 2020: MATH UN3020
Course Number Section/Call Number Times/Location Instructor Points Enrollment
MATH 3020 001/12108 M W 10:10am - 11:25am 312 Mathematics Building Shotaro Makisumi 3 94/116

MATH UN3025 Making, Breaking Codes. 3 points.
Prerequisites: (MATH UN1101 and MATH UN1102 and MATH UN2010) and MATH UN2010.
A concrete introduction to abstract algebra. Topics in abstract algebra used in cryptography and coding theory.
MATH UN3027 Ordinary Differential Equations. 3 points.
Prerequisites: MATH UN102 and MATH UN1201 or the equivalent.
Corequisites: MATH UN2010

Fall 2020: MATH UN3027
Course Number: 3027
Section/Call Number: 001/11478
Times/Location: T Th 11:40am - 12:55pm
Instructor: Simon Brendle
Points: 3
Enrollment: 56/116

MATH UN3028 Partial Differential Equations. 3 points.
Prerequisites: MATH UN3027 and MATH UN2010 or the equivalent

Spring 2020: MATH UN3028
Course Number: 3028
Section/Call Number: 001/12110
Times/Location: T Th 11:40am - 12:55pm
Instructor: Panagiotis Tsakonas
Points: 3
Enrollment: 43/100

MATH UN3050 Discrete Time Models in Finance. 3 points.
Prerequisites: (MATH UN1102 and MATH UN1201) or (MATH UN101 and MATH UN1202 and MATH UN201) and MATH UN2010
Recommended: MATH UN3027 (or MATH UN2030 and SIEO W3600)
Elementary discrete time methods for pricing financial instruments, such as options. Notions of arbitrage, risk-neutral valuation, hedging, term-structure of interest rates.

Spring 2020: MATH UN3050
Course Number: 3050
Section/Call Number: 001/12111
Times/Location: M W 6:10pm - 7:25pm
Instructor: Mikhail Smirnov
Points: 3
Enrollment: 56/100

MATH UN3386 Differential Geometry. 3 points.
Prerequisites: MATH UN1202 or the equivalent
Local and global differential geometry of submanifolds of Euclidean 3-space. Frenet formulas for curves. Various types of curvatures for curves and surfaces and their relations. The Gauss-Bonnet theorem.

Fall 2020: MATH UN3386
Course Number: 3386
Section/Call Number: 001/11484
Times/Location: T Th 11:40am - 12:55pm
Instructor: Richard Hamilton
Points: 3
Enrollment: 34/49

MATH UN3901 Supervised Readings in Mathematics I. 2-3 points.
Prerequisites: The written permission of the staff member who agrees to act as sponsor (sponsorship limited to full-time instructors on the staff list), as well as the permission of the Director of Undergraduate Studies. The written permission must be deposited with the Director of Undergraduate Studies before registration is completed. Guided reading and study in mathematics. A student who wishes to undertake individual study under this program must present a specific project to a member of the staff and secure his or her willingness to act as sponsor. Written reports and periodic conferences with the instructor.

Spring 2020: MATH UN3901
Course Number: 3901
Section/Call Number: 001/20030
Times/Location: T Th 11:40am - 12:55pm
Instructor: Simon Brendle
Points: 3
Enrollment: 3/5

MATH UN3902 Supervised Readings in Mathematics II. 2-3 points.
Prerequisites: The written permission of the staff member who agrees to act as sponsor (sponsorship limited to full-time instructors on the staff list), as well as the permission of the Director of Undergraduate Studies. The written permission must be deposited with the Director of Undergraduate Studies before registration is completed. Guided reading and study in mathematics. A student who wishes to undertake individual study under this program must present a specific project to a member of the staff and secure his or her willingness to act as sponsor. Written reports and periodic conferences with the instructor.

Spring 2020: MATH UN3902
Course Number: 3902
Section/Call Number: 001/20030
Times/Location: T Th 11:40am - 12:55pm
Instructor: Simon Brendle
Points: 3
Enrollment: 47/100

MATH UN3951 Undergraduate Seminars in Mathematics I. 3 points.
Prerequisites: Two years of calculus, at least one year of additional mathematics courses, and the director of undergraduate studies’ permission.
The subject matter is announced at the start of registration and is different in each section. Each student prepares talks to be given to the seminar, under the supervision of a faculty member or senior teaching fellow.

Fall 2020: MATH UN3951
Course Number: 3951
Section/Call Number: 001/00120
Times/Location: M W 6:10pm - 7:25pm
Instructor: Daniele De Silva
Points: 3
Enrollment: 32/64

MATH UN3952 Undergraduate Seminars in Mathematics II. 3 points.
Prerequisites: Two years of calculus, at least one year of additional mathematics courses, and the director of undergraduate studies’ permission.
The subject matter is announced at the start of registration and is different in each section. Each student prepares talks to be given to the seminar, under the supervision of a faculty member or senior teaching fellow. Prerequisite: two years of calculus, at least one year of additional mathematics courses, and the director of undergraduate studies’ permission.

Spring 2020: MATH UN3952
Course Number: 3952
Section/Call Number: 002/12112
Times/Location: M W 6:10pm - 7:25pm
Instructor: Daniele De Silva
Points: 3
Enrollment: 47/100

MATH V3997 Supervised Individual Research. 3 points.
Prerequisites: the written permission of the faculty member who agrees to act as a supervisor, and the director of undergraduate studies’ permission.
For specially selected mathematics majors, the opportunity to write a senior thesis on a problem in contemporary mathematics under the supervision of a faculty member.
MATH V3998 Supervised Individual Research. 3 points.
Prerequisites: the written permission of the faculty member who agrees to act as a supervisor, and the director of undergraduate studies’ permission.
For specially selected mathematics majors, the opportunity to write a senior thesis on a problem in contemporary mathematics under the supervision of a faculty member.

MATH UN1003 College Algebra and Analytic Geometry. 3 points.
Prerequisites: score of 550 on the mathematics portion of the SAT completed within the last year or the appropriate grade on the General Studies Mathematics Placement Examination. Columbia College students do not receive any credit for this course and must see their CSA advising dean. For students who wish to study calculus but do not know analytic geometry. Algebra review, graphs and functions, polynomial functions, rational functions, conic sections, systems of equations in two variables, exponential and logarithmic functions, trigonometric functions and trigonometric identities, applications of trigonometry, sequences, series, and limits.

Spring 2020: MATH UN1003
Course Number  Section/Call Number  Times/Location  Instructor  Points  Enrollment
MATH 1003  002/12023  T Th 11:40am - 12:55pm  407 Mathematics Building  Yier Lin  3 10/30
MATH 1003  003/00593  M W 6:10pm - 7:25pm  302 Barnard Hall  Lindsay Pieloch  3 26/36

Fall 2020: MATH UN1003
Course Number  Section/Call Number  Times/Location  Instructor  Points  Enrollment
MATH 1003  001/11290  M W 6:10pm - 7:25pm  Room TBA  Alexander Piechnik  3 3/30
MATH 1003  002/11291  T Th 2:40pm - 3:55pm  Room TBA  Mudul Thatte  3 4/30

MATH GU4007 Analytic Number Theory. 3 points.
Prerequisites: MATH UN3007
A one semester course covering the theory of modular forms, zeta functions, L-functions, and the Riemann hypothesis. Particular topics covered include the Riemann zeta function, the prime number theorem, Dirichlet characters, Dirichlet L-functions, Siegel zeros, prime number theorem for arithmetic progressions, SL (2, Z) and subgroups, quotients of the upper half-plane and cusps, modular forms, Fourier expansions of modular forms, Hecke operators, L-functions of modular forms.

Spring 2020: MATH GU4007
Course Number  Section/Call Number  Times/Location  Instructor  Points  Enrollment
MATH 4007  001/12113  M W 2:40pm - 3:55pm  307 Mathematics Building  Evan Warner  3 4/20

MATH GU4032 Fourier Analysis. 3 points.
Prerequisites: three terms of calculus and linear algebra or four terms of calculus.
Prerequisite: three terms of calculus and linear algebra or four terms of calculus. Fourier series and integrals, discrete analogues, inversion and Poisson summation formulae, convolution. Heisenberg uncertainty principle. Stress on the application of Fourier analysis to a wide range of disciplines.

Spring 2020: MATH GU4032
Course  Section/Call Number  Times/Location  Instructor  Points  Enrollment
MATH 4032  001/12115  M W 11:40am - 12:55pm  520 Mathematics Building  Peter Woit  3 22/50

MATH GU4041 INTRO MODERN ALGEBRA I. 3 points.
Prerequisites: MATH UN1102 and MATH UN1202 and MATH UN2010 or the equivalent
The second term of this course may not be taken without the first. Groups, homomorphisms, rings, ideals, fields, polynomials, field extensions, Galois theory.

Spring 2020: MATH GU4041
Course  Section/Call Number  Times/Location  Instructor  Points  Enrollment
MATH 4041  001/12116  T Th 10:10am - 11:25am  520 Mathematics Building  Michael Harris  3 43/55

Fall 2020: MATH GU4041
Course  Section/Call Number  Times/Location  Instructor  Points  Enrollment
MATH 4041  001/11487  M W 2:40pm - 3:55pm  Room TBA  Robert Friedman  3 87/110

MATH GU4042 INTRO MODERN ALGEBRA II. 3 points.
Prerequisites: MATH UN1102 and MATH UN1202 and MATH UN2010 or the equivalent.
The second term of this course may not be taken without the first. Rings, homomorphisms, ideals, integral and Euclidean domains, the division algorithm, principal ideal and unique factorization domains, fields, algebraic and transcendental extensions, splitting fields, finite fields, Galois theory.

Spring 2020: MATH GU4042
Course  Section/Call Number  Times/Location  Instructor  Points  Enrollment
MATH 4042  001/12121  T Th 1:10pm - 2:25pm  417 Mathematics Building  Yihang Zhu  3 42/50

Fall 2020: MATH GU4042
Course  Section/Call Number  Times/Location  Instructor  Points  Enrollment
MATH 4042  001/11488  M W 1:10pm - 2:25pm  Room TBA  Mikhail Khovanov  3 16/35

MATH GU4043 Algebraic Number Theory. 3 points.
Prerequisites: MATH GU4041 and MATH GU4042 or the equivalent Algebraic number fields, unique factorization of ideals in the ring of algebraic integers in the field into prime ideals. Dirichlet unit theorem, finiteness of the class number, ramification. If time permits, p-adic numbers and Dedekind zeta function.
MATH GU4044 Representations of Finite Groups. 3 points.
Prerequisites: MATH UN2010 and MATH GU4041 or the equivalent.
Finite groups acting on finite sets and finite dimensional vector spaces. Group characters. Relations with subgroups and factor groups. Arithmetic properties of character values. Applications to the theory of finite groups: Frobenius groups, Hall subgroups and solvable groups. Characters of the symmetric groups. Spherical functions on finite groups.

Fall 2020: MATH GU4044
Course Number Section/Call Times/Location Instructor Points Enrollment
MATH 4044 001/11490 T Th 1:10pm - 2:25pm Room TBA Chao Li 3 10/19

MATH GU4045 Algebraic Curves. 3 points.
Prerequisites: (MATH GU4041 and MATH GU4042) and MATH UN3007 Plane curves, affine and projective varieties, singularities, normalization, Riemann surfaces, divisors, linear systems, Riemann-Roch theorem.

Spring 2020: MATH GU4045
Course Number Section/Call Times/Location Instructor Points Enrollment
MATH 4045 001/12122 M W 4:10pm - 5:25pm 528 Mathematics Building Akash Sengupta 3 9/20

MATH W4046 Introduction to Category Theory. 3 points.
CC/GS: Partial Fulfillment of Science Requirement
Not offered during 2019-20 academic year.
Prerequisites: MATH W4041.
Categories, functors, natural transformations, adjoint functors, limits and colimits, introduction to higher categories and diagrammatic methods in algebra.

MATH GU4051 Topology. 3 points.
Prerequisites: (MATH UN1202 and MATH UN2010) and rudiments of group theory (e.g., MATH GU4041). MATH UN1208 or MATH GU4061 is recommended, but not required.

Fall 2020: MATH GU4051
Course Number Section/Call Times/Location Instructor Points Enrollment
MATH 4051 001/11491 T Th 11:40am - 12:55pm Room TBA Stephen Miller 3 37/64

MATH GU4052 Introduction to Knot Theory. 3 points.
CC/GS: Partial Fulfillment of Science Requirement
Prerequisites: MATH GU4051 Topology and / or MATH GU4061 Introduction To Modern Analysis I (or equivalents). Recommended (can be taken concurrently): MATH UN2010 linear algebra, or equivalent.
The study of algebraic and geometric properties of knots in R^3, including but not limited to knot projections and Reidemeister's theorem, Seifert surfaces, braids, tangles, knot polynomials, fundamental group of knot complements. Depending on time and student interest, we will discuss more advanced topics like knot concordance, relationship to 3-manifold topology, other algebraic knot invariants.

MATH GU4053 Introduction to Algebraic Topology. 3 points.
Prerequisites: MATH UN2010 and MATH GU4041 and MATH GU4051
The study of topological spaces from algebraic properties, including the essentials of homology and the fundamental group. The Brouwer fixed point theorem. The homology of surfaces. Covering spaces.

Spring 2020: MATH GU4053
Course Number Section/Call Times/Location Instructor Points Enrollment
MATH 4053 001/12123 T Th 2:40pm - 3:55pm 307 Mathematics Building Oleg Lazarev 3 8/50

MATH GU4061 INTRO MODERN ANALYSIS I. 3 points.
Prerequisites: MATH UN1202 or the equivalent, and MATH UN2010. The second term of this course may not be taken without the first.
Prerequisites: MATH UN1202 or the equivalent, and MATH UN2010.
The second term of this course may not be taken without the first. Real numbers, metric spaces, elements of general topology, sequences and series, continuity, differentiation, integration, uniform convergence, Ascoli-Arzela theorem, Stone-Weierstrass theorem.

Spring 2020: MATH GU4061
Course Number Section/Call Times/Location Instructor Points Enrollment
MATH 4061 001/12124 M W 1:10pm - 2:25pm 417 Mathematics Building Hui Yu 3 45/64
MATH 4061 002/12125 M W 4:10pm - 5:25pm 417 Mathematics Building Hui Yu 3 38/64

Fall 2020: MATH GU4061
Course Number Section/Call Times/Location Instructor Points Enrollment
MATH 4061 001/11494 T Th 2:40pm - 3:55pm Room TBA Henri Roesch 3 35/100
MATH 4061 002/11495 T Th 4:10pm - 5:25pm Room TBA Henri Roesch 3 19/100

MATH GU4062 Introduction To Modern Analysis II. 3 points.
Prerequisites: MATH UN1202 or the equivalent, and MATH UN2010. The second term of this course may not be taken without the first.

Spring 2020: MATH GU4062
Course Number Section/Call Times/Location Instructor Points Enrollment
MATH 4062 001/12126 M W 1:10pm - 2:25pm 407 Mathematics Building Evgeni Dimitrov 3 22/65

Fall 2020: MATH GU4062
Course Number Section/Call Times/Location Instructor Points Enrollment
MATH 4062 001/11498 M W 4:10pm - 5:25pm Room TBA Hui Yu 3 24/49
MATH GU4065 Honors Complex Variables. 3 points.
Prerequisites: (MATH UN1207 and MATH UN1208) or MATH GU4061
A theoretical introduction to analytic functions. Holomorphic functions, harmonic functions, power series, Cauchy-Riemann equations, Cauchy's integral formula, poles, Laurent series, residue theorem. Other topics as time permits: elliptic functions, the gamma and zeta function, the Riemann mapping theorem, Riemann surfaces, Nevanlinna theory.

Fall 2020: MATH GU4065
Course | Section/Call | Times/Location | Instructor | Points | Enrollment
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MATH 4065 | 001/11503 | T Th 10:10am - 11:25am Room TBA | Julien Dubédat | 3 | 20/20

MATH W4071 Introduction to the Mathematics of Finance. 3 points.
Prerequisites: MATH V1202, MATH V3027, STAT W4150, SEIOW4150, or their equivalents.
The mathematics of finance, principally the problem of pricing of derivative securities, developed using only calculus and basic probability. Topics include mathematical models for financial instruments, Brownian motion, normal and lognormal distributions, the Black-Scholes formula, and binomial models.

MATH GU4081 Introduction to Differentiable Manifolds. 3 points.
Prerequisites: (MATH GU4051 or MATH GU4061) and MATH UN2010

Fall 2020: MATH GU4081
Course | Section/Call | Times/Location | Instructor | Points | Enrollment
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MATH 4081 | 001/00119 | M W 10:10am - 11:25am Room TBA | Dusa McDuff | 3 | 12/40

MATH GU4155 Probability Theory. 3 points.
Prerequisites: MATH GU4061 or MATH UN3007

Spring 2020: MATH GU4155
Course | Section/Call | Times/Location | Instructor | Points | Enrollment
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MATH 4155 | 001/12127 | T Th 4:10pm - 5:25pm 520 Mathematics Building | Ioannis Karatzas | 3 | 24/55

MATH W4392 Quantum Mechanics: An Introduction for Mathematicians and Physicists II. 3 points.
Not offered during 2019-20 academic year.
Prerequisites: MATH V1202 or the equivalent, MATH V2010, and MATH W4391.
This course will focus on quantum mechanics, paying attention to both the underlying mathematical structures as well as their physical motivations and consequences. It is meant for undergraduates with no previous formal training in quantum theory. The measurement problem and issues of non-locality will be stressed.

Cross-Listed Courses
Computer Science
COMS S3251 Computational Linear Algebra. 3 points.
Not offered during 2019-20 academic year.
Prerequisites: two terms of calculus.
Computational linear algebra, solution of linear systems, sparse linear systems, least squares, eigenvalue problems, and numerical solution of other multivariate problems as time permits.

COMS W4203 Graph Theory. 3 points.
Lect: 3.
Prerequisites: (COMS W3203)
General introduction to graph theory. Isomorphism testing, algebraic specification, symmetries, spanning trees, traversability, planarity, drawings on higher-order surfaces, colorings, extremal graphs, random graphs, graphical measurement, directed graphs, Burnside-Polya counting, voltage graph theory.

COMS W3203 Discrete Mathematics: Introduction to Combinatorics and Graph Theory. 3 points.
Lect: 3.
Prerequisites: Any introductory course in computer programming. Logic and formal proofs, sequences and summation, mathematical induction, binomial coefficients, elements of finite probability, recurrence relations, equivalence relations and partial orderings, and topics in graph theory (including isomorphism, traversability, planarity, and colorings).
Industrial Engineering and Operations Research

CSOR E4010 Graph Theory: A Combinatorial View. 3 points.

Prerequisites: Linear Algebra, or instructor's permission.
Graph Theory is an important part of the theoretical basis of operations research. A good understanding of the basic fundamentals of graph theory is necessary in order to apply the theory successfully in the future. This is an introductory course in graph theory with emphasis on its combinatorial aspects. It covers basic definitions, and some fundamental concepts in graph theory and its applications. Topics include trees and forests, graph coloring, connectivity, matching theory and others. This course will provide a solid foundation for students in the IEOR department, on which further courses may build.