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 (on Columbia’s campus) and one in 502 Milstein Center (on Barnard’s campus), are available. Hours will be posted in the rooms and on [https://math.barnard.edu/math-tutoring-schedules](https://math.barnard.edu/math-tutoring-schedules) for students seeking individual help and counseling from Barnard tutors and Columbia teaching assistants. No appointments are necessary. Both Barnard and Columbia students are welcome. NOTE: Changes to tutoring schedules and remote tutoring can occur in response to COVID-19.

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>Honors Math A-B</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 INTRO 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 (Ann Whitney Olin Professor of Mathematics)

Professor
Dusa McDuff (Joan Lyttle Birman ’48 Chair of Mathematics)

Assistant Professor
Alisa Knizel

Term Associate Professors
Cristian Iovanov
Lindsay Piechnik

Professors Emeriti
Dave Bayer
Joan Birman
Walter Neumann

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 (a minimum of 35 credits) as follows:

- Four courses in calculus or Honors Mathematics A-B, including Advanced Placement Credit. A student who places out of Calc I/II with AP credits, will need to take a replacement course.
- Six courses in mathematics numbered at or above 2000.
• 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>INTRO MODERN ANALYSIS II (II)</td>
</tr>
<tr>
<td>MATH UN3951</td>
<td>UNDERGRADUATE SEMINARS I (at least one term)</td>
</tr>
<tr>
<td>or MATH UN3952</td>
<td>UNDERGRADUATE SEMINARS II</td>
</tr>
</tbody>
</table>

* Note: It is strongly recommended that the sequences MATH GU4041 INTRO MODERN ALGEBRA I - MATH GU4061 INTRO MODERN ANALYSIS I and MATH GU4062 INTRO 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 INTRO MODERN ANALYSIS II with one or two of the following courses:

• MATH UN2500 ANALYSIS AND OPTIMIZATION,
• MATH UN3007 COMPLEX VARIABLES,
• MATH GU4032 FOURIER ANALYSIS

and may replace MATH GU4042 INTRO MODERN ALGEBRA II with

• MATH UN3020 NUMBER THEORY AND CRYPTOGRAPHY
• MATH UN3025 MAKING, BREAKING CODES

In exceptional cases, the chair will approve the substitution of certain more advanced courses for those mentioned above.

For a major in Applied Mathematics: 14 courses (a minimum of 35 credits)

Four courses in calculus or Honors Mathematics A-B, including Advanced Placement Credit. A student that places out of Calc I/II with AP credits, will need to take a replacement course.

<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 GU4061</td>
<td>INTRO MODERN ANALYSIS I</td>
</tr>
<tr>
<td>APMA E4901</td>
<td>SEM-PROBLEMS IN APPLIED MATH</td>
</tr>
<tr>
<td>APMA E4903</td>
<td>SEM-PROBLEMS IN APPLIED MATH</td>
</tr>
<tr>
<td>APMA E3900</td>
<td>UNDERGRAD RES IN APPLIED MATH (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 Name</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>FUNCTNS OF A COMPLEX VARIABLE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<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>COMPUT MATH:INTRO-NUMERCL METH</td>
</tr>
<tr>
<td>APMA E4101</td>
<td>APPL MATH III:DYNAMICAL SYSTMS</td>
</tr>
<tr>
<td>APMA E4150</td>
<td>APPLIED FUNCTIONAL ANALYSIS</td>
</tr>
</tbody>
</table>

For a major in Mathematical Sciences: 14 courses (a minimum of 38 credits):

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 Name</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>INTRO 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>

Possible further courses selected from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH UN1202</td>
<td>CALCULUS IV</td>
</tr>
<tr>
<td>MATH UN2500</td>
<td>ANALYSIS AND OPTIMIZATION</td>
</tr>
<tr>
<td>MATH UN3020</td>
<td>NUMBER THEORY AND CRYPTOGRAPHY</td>
</tr>
<tr>
<td>MATH UN3025</td>
<td>MAKING, BREAKING CODES</td>
</tr>
</tbody>
</table>

Any 3 credit MATH course numbered 2000 or above

Statistics

Select at least one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT UN1101</td>
<td>INTRODUCTION TO STATISTICS</td>
</tr>
<tr>
<td>STAT UN1201</td>
<td>CALC-BASED INTRO TO STATISTICS</td>
</tr>
<tr>
<td>or equivalent</td>
<td></td>
</tr>
</tbody>
</table>

Other courses from the Statistics list (eg, STAT UN2102, STAT UN2103, STAT UN2104, STAT UN3105, STAT UN3106)

Computer Science

Select at least one of the following programming courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMS W1002</td>
<td>COMPUTING IN CONTEXT</td>
</tr>
<tr>
<td>COMS W1004</td>
<td>Introduction to Computer Science and Programming in Java (preferred)</td>
</tr>
<tr>
<td>COMS W1005</td>
<td>Introduction to Computer Science and Programming in MATLAB</td>
</tr>
<tr>
<td>COMS W3107</td>
<td>Clean Object-Oriented Design</td>
</tr>
</tbody>
</table>

Possible further courses selected from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other classes from the Computer Science Core</td>
<td></td>
</tr>
<tr>
<td>COMS W3203</td>
<td>DISCRETE MATHEMATICS</td>
</tr>
<tr>
<td>COMS W3210</td>
<td>Scientific Computation</td>
</tr>
<tr>
<td>ENGI E1006</td>
<td>INTRO TO COMP FOR ENG/APP SCI</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.

NOTE: A student that places out of Calc I/II with AP credits, will need to take a replacement course.

NOTE: Students may not take for credit COMS W3107 if they already received credit for COMS W1007.

For a major in Mathematics-Statistics: 14 courses (a minimum of 38 credits):

Mathematics
Select one of the following sequences:

- MATH UN1101 and CALCLUS I
- MATH UN1102 and CALCLUS II
- MATH UN1201 and CALCLUS III
- MATH UN2010 and LINEAR ALGEBRA
- MATH UN2500 and ANALYSIS AND OPTIMIZATION

MATH UN1207 HONORS MATHEMATICS A
- MATH UN1208 and HONORS MATHEMATICS B
- MATH UN2500 and ANALYSIS AND OPTIMIZATION

Statistics
Statistics required courses:

- STAT UN1201 CALCULUS-BASED INTRO TO STATISTICS
- STAT GU4203 PROBABILITY THEORY
- STAT GU4204 STATISTICAL INFERENCE
- STAT GU4205 LINEAR REGRESSION MODELS

And select one of the following courses:

- STAT GU4207 ELEMENTARY STOCHASTIC PROCESS
- STAT GU4262 Stochastic Processes for Finance
- STAT GU4264 STOCHASTIC PROCESSES-APPLCITNS I
- STAT GU4265 STOCHASTIC METHODS IN FINANCE

Computer Science
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 W3107 Clean Object-Oriented Design
- ENGI E1006 INTRO TO COMP FOR ENG/APP SCI

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.

NOTE: A student that places out of Calc I/II with AP credits, will need to take a replacement course.

NOTE: Students may not take for credit COMS W3107 if they already received credit for COMS W1007.

For a major in Mathematics-Computer Science 15 courses (a minimum of 38 credits):

Mathematics
Four courses in calculus or Honors Mathematics A-B, including Advanced Placement Credit. A student that places out of Calc I/II with AP credits, will need to take a replacement course; 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 I (at least one term)

or MATH UN3952 UNDERGRADUATE SEMINARS 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
- COMS W3261 COMPUTER SCIENCE THEORY
- CSEE W3827 FUNDAMENTALS OF COMPUTER SYSTS

Note A: AP Computer Science with a grade of 4 or 5 or similar experience is a prerequisite for COMS W1007.

Electives: Two additional electives from computer science or math should be included. At least one should be level 3000 or higher; the second should be level 2000 or higher. With adviser approval, appropriate electives from other departments can be considered, such as Statistics or Applied Math.

- 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

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-ANLYTIC 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-ANLYTC GEOMTRY. 3.00 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. 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.

<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>001/12296</td>
<td>M W 11:40am - 12:55pm 407 Mathematics Building</td>
<td>Tae Seok Lee</td>
<td>3.00</td>
<td>19/30</td>
</tr>
<tr>
<td>MATH 1003</td>
<td>002/12298</td>
<td>T Th 6:10pm - 7:25pm 407 Mathematics Building</td>
<td>Baiqing Zhu</td>
<td>3.00</td>
<td>16/30</td>
</tr>
</tbody>
</table>

Spring 2024: MATH UN1003

MATH UN1101 CALCULUS I. 3.00 points.
Prerequisites: (see Courses for First-Year Students). Functions, limits, derivatives, introduction to integrals, or an understanding of pre-calculus will be assumed. (SC)

<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>001/00226</td>
<td>M W 6:10pm - 7:25pm Li002 Milstein Center</td>
<td>Lindsay Piechnik</td>
<td>3.00</td>
<td>95/100</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>002/12300</td>
<td>T Th 10:10am - 11:25am 413 Kent Hall</td>
<td>Mridul Thatte</td>
<td>3.00</td>
<td>42/100</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>003/12301</td>
<td>T Th 2:40pm - 3:55pm 703 Hamilton Hall</td>
<td>Alex Xu</td>
<td>3.00</td>
<td>25/30</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>004/12302</td>
<td>T Th 6:10pm - 7:25pm 312 Mathematics Building</td>
<td>Amal Matttoo</td>
<td>3.00</td>
<td>16/30</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>005/12303</td>
<td>M W 2:40pm - 3:55pm 203 Mathematics Building</td>
<td>Mridul Thatte</td>
<td>3.00</td>
<td>48/100</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>006/12304</td>
<td>M W 4:10pm - 5:25pm 203 Mathematics Building</td>
<td>Jorge Pineiro Barcelo</td>
<td>3.00</td>
<td>44/100</td>
</tr>
</tbody>
</table>

Fall 2024: 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>001/00081</td>
<td>T Th 1:10pm - 2:25pm 263 Macy Hall</td>
<td>Lindsay Piechnik</td>
<td>3.00</td>
<td>52/80</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>002/00082</td>
<td>T Th 2:40pm - 3:55pm 405 Milbank Hall</td>
<td>Lindsay Piechnik</td>
<td>3.00</td>
<td>35/80</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>003/11833</td>
<td>M W 10:10am - 11:25am Room TBA</td>
<td>Marco Castronovo</td>
<td>3.00</td>
<td>9/100</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>004/11835</td>
<td>M W 11:40am - 12:55pm Room TBA</td>
<td>Marco Castronovo</td>
<td>3.00</td>
<td>9/100</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>005/11837</td>
<td>M W 2:40pm - 3:55pm Room TBA</td>
<td>George Dragomir</td>
<td>3.00</td>
<td>24/100</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>006/11838</td>
<td>M W 4:10pm - 5:25pm Room TBA</td>
<td>0. FACULTY</td>
<td>3.00</td>
<td>5/30</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>007/11840</td>
<td>M W 6:10pm - 7:25pm Room TBA</td>
<td>Marco Sangiovanni Vincentelli</td>
<td>3.00</td>
<td>4/100</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>008/11841</td>
<td>T Th 10:10am - 11:25am Room TBA</td>
<td>0. FACULTY</td>
<td>3.00</td>
<td>6/30</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>009/11842</td>
<td>T Th 11:40am - 12:55pm Room TBA</td>
<td>George Dragomir</td>
<td>3.00</td>
<td>13/100</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>010/11844</td>
<td>T Th 4:10pm - 5:25pm Room TBA</td>
<td>Marco Sangiovanni Vincentelli</td>
<td>3.00</td>
<td>2/100</td>
</tr>
<tr>
<td>MATH 1101</td>
<td>011/11845</td>
<td>T Th 6:10pm - 7:25pm Room TBA</td>
<td>0. FACULTY</td>
<td>3.00</td>
<td>1/30</td>
</tr>
</tbody>
</table>
MATH UN1102 CALCULUS II. 3.00 points.
Prerequisites: MATH UN1101 or the equivalent.
Prerequisites: MATH UN1101 or the equivalent. Methods of integration, applications of the integral, Taylor's theorem, infinite series. (SC)

Spring 2024: 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>001/00227</td>
<td>T Th 2:40pm - 3:55pm</td>
<td>Lindsay Piekloch</td>
<td>3.00</td>
<td>57/60</td>
</tr>
<tr>
<td>MATH 1102</td>
<td>002/12305</td>
<td>T Th 10:10am - 11:25am 203 Mathematics Building</td>
<td>Lucy Yang</td>
<td>3.00</td>
<td>34/100</td>
</tr>
<tr>
<td>MATH 1102</td>
<td>003/12306</td>
<td>T Th 1:10pm - 2:25pm 417 Mathematics Building</td>
<td>Tomasz Owsian</td>
<td>3.00</td>
<td>61/64</td>
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<tr>
<td>MATH 1102</td>
<td>004/12307</td>
<td>T Th 6:10pm - 7:25pm 520 Mathematics Building</td>
<td>Fan Zhou</td>
<td>3.00</td>
<td>11/30</td>
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<tr>
<td>MATH 1102</td>
<td>005/12308</td>
<td>M W 11:40am - 12:55pm 520 Mathematics Building</td>
<td>Davis Lazowski</td>
<td>3.00</td>
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<tr>
<td>MATH 1102</td>
<td>006/12309</td>
<td>M W 2:40pm - 3:55pm 312 Mathematics Building</td>
<td>Andres Fernandez Herrero</td>
<td>3.20</td>
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<tr>
<td>MATH 1102</td>
<td>007/12310</td>
<td>M W 4:10pm - 5:25pm 312 Mathematics Building</td>
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Fall 2024: MATH UN1102

<table>
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<th>Times/Location</th>
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<tr>
<td>MATH 1102</td>
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<td>MATH 1102</td>
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<td>T Th 8:40am - 9:55am Room TBA</td>
<td>Lucy Yang</td>
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<tr>
<td>MATH 1102</td>
<td>006/11852</td>
<td>T Th 6:10pm - 7:25pm Room TBA</td>
<td>Elliott Stein</td>
<td>3.00</td>
<td>27/64</td>
</tr>
</tbody>
</table>

MATH UN1201 CALCULUS III. 3.00 points.
Prerequisites: MATH UN1101 or the equivalent
Prerequisites: MATH UN1101 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)

Spring 2024: MATH UN1201

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>MATH 1201</td>
<td>001/00228</td>
<td>M W 10:10am - 11:25am 405 Milbank Hall</td>
<td>Cristian Iovanov</td>
<td>3.00</td>
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<tr>
<td>MATH 1201</td>
<td>002/00229</td>
<td>M W 11:40am - 12:55pm 332 Milbank Hall</td>
<td>Cristian Iovanov</td>
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<td>57/60</td>
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<tr>
<td>MATH 1201</td>
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<td>Ivan Horozov</td>
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<td>94/106</td>
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<tr>
<td>MATH 1201</td>
<td>004/12318</td>
<td>T Th 11:40am - 12:55pm 312 Mathematics Building</td>
<td>Shaoyun Bai</td>
<td>3.00</td>
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<tr>
<td>MATH 1201</td>
<td>005/12320</td>
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<td>Jeanne Boursier</td>
<td>3.00</td>
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<tr>
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Fall 2024: MATH UN1201

<table>
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<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
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<th>Points</th>
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<td>Deeparaj Bhat</td>
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<td>Brian Harvie</td>
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<td>42/100</td>
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<td>29/100</td>
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<tr>
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<td>Gyu Jin Oh</td>
<td>3.00</td>
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<td>007/11861</td>
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<td>Yoonjoo Kim</td>
<td>3.00</td>
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<td>008/11862</td>
<td>T Th 4:10pm - 5:25pm Room TBA</td>
<td>Yoonjoo Kim</td>
<td>3.00</td>
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MATH UN1202 CALCULUS IV. 3.00 points.
Prerequisites: MATH UN1102 and MATH UN1201 or the equivalent
Prerequisites: MATH UN1102 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 2024: MATH UN1202

<table>
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<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<th>Enrollment</th>
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<td>MATH 1202</td>
<td>001/12325</td>
<td>M W 4:10pm - 5:25pm 417 Mathematics Building</td>
<td>Qiao He</td>
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Fall 2024: MATH UN1202

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<th>Instructor</th>
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<th>Enrollment</th>
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<tr>
<td>MATH 1202</td>
<td>001/00012</td>
<td>M W 10:10am - 11:25am 504 Diana Center</td>
<td>Daniela De Silva</td>
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<tr>
<td>MATH 1202</td>
<td>002/11863</td>
<td>M W 6:10pm - 7:25pm Room TBA</td>
<td>Mikhail Smirnov</td>
<td>3.00</td>
<td>43/100</td>
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</table>
MATH UN 1206

**MATH 1206:** HONORS MATHEMATICS A. 4.00 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.

<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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<tr>
<td>MATH 1206</td>
<td>001/11865</td>
<td>T Th 11:40am - 12:55pm Room TBA</td>
<td>Giulia Sacca</td>
<td>4.00</td>
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</table>

MATH UN 1208

**MATH 1208:** HONORS MATHEMATICS B. 4.00 points.
Prerequisites: (see Courses for First-Year Students).
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.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<th>Enrollment</th>
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<tr>
<td>MATH 1208</td>
<td>001/12329</td>
<td>T Th 1:10pm - 2:25pm 603 Hamilton Hall</td>
<td>George Dragomir</td>
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MATH UN 2000

**MATH 2000 INTRO TO HIGHER MATHEMATICS. 3.00 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)

<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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<tr>
<td>MATH 2000</td>
<td>001/12330</td>
<td>T Th 1:10pm - 2:25pm 520 Mathematics Building</td>
<td>Giulia Sacca</td>
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Fall 2024: MATH UN 2000

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<th>Enrollment</th>
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<tr>
<td>MATH 2000</td>
<td>001/00013</td>
<td>M W 10:10am - 11:25am 328 Milbank Hall</td>
<td>Dusa McDuff</td>
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MATH BC 2001

**MATH BC 2001 PERSPECTIVES IN MATHEMATICS. 1.00 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 explores some current applications of mathematics in the sciences, technology and economics

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
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<tr>
<td>MATH 2001</td>
<td>001/00231</td>
<td>W 1:10pm - 2:00pm Ll003 Diana Center</td>
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MATH BC 2006

**MATH BC 2006 COMBINATORICS. 3.00 points.**

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<th>Instructor</th>
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<tr>
<td>MATH 2006</td>
<td>001/00254</td>
<td>T Th 10:10am - 11:25am 328 Milbank Hall</td>
<td>Alisa Knizel</td>
<td>3.00</td>
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</table>

MATH UN 2010

**MATH UN 2010 LINEAR ALGEBRA. 3.00 points.**
Matrices, vector spaces, linear transformations, eigenvalues and eigenvectors, canonical forms, applications. (SC)

<table>
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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>
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<td>001/12334</td>
<td>M W 10:10am - 11:25am 312 Mathematics Building</td>
<td>Amadou Bah</td>
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Spring 2024: MATH UN 2010

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Fall 2024: MATH UN 2010

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<td>Siddhi Krishna</td>
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Spring 2024: MATH UN 2030

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<th>Points</th>
<th>Enrollment</th>
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<tbody>
<tr>
<td>MATH 2030</td>
<td>001/12341</td>
<td>M W 10:10am - 11:25am 203 Mathematics Building</td>
<td>Ovidiu Savin</td>
<td>3.00</td>
<td>93/100</td>
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</table>

MATH UN 2020 Honors Linear Algebra. 3 points.
Not offered during 2023-2024 academic year.

Prerequisites: MATH UN1201. A more extensive treatment of the material in MATH UN2010, with increased emphasis on proof. Not to be taken in addition to MATH UN2010 or MATH UN1207-MATH UN1208.

MATH UN 2030

**MATH UN 2030 ORDINARY DIFFERENTIAL EQUATIONS. 3.00 points.**
Prerequisites: MATH UN1102 and MATH UN1201 or the equivalent.
Prerequisites: MATH UN1102 and MATH UN1201 or the equivalent. Special differential equations of order one. Linear differential equations with constant and variable coefficients. Systems of such equations. Transform and series solution techniques. Emphasis on applications

<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 2030</td>
<td>002/11872</td>
<td>M W 1:10pm - 2:25pm Room TBA</td>
<td>Panagiota Daskalopoulos</td>
<td>3.00</td>
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Fall 2024: MATH UN 2030

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<tr>
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<td>002/11873</td>
<td>T Th 10:10am - 11:25am Room TBA</td>
<td>Jeanne Bourier</td>
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Spring 2024: MATH UN 2030

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<td>MATH 2030</td>
<td>003/11874</td>
<td>T Th 1:10pm - 2:25pm Room TBA</td>
<td>Jeanne Bourier</td>
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<td>44/49</td>
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</table>
MATH UN2500 ANALYSIS AND OPTIMIZATION. 3.00 points.
Prerequisites: MATH UN1102 and MATH UN1201 or the equivalent and MATH UN2010.
Prerequisites: MATH UN1102 and MATH UN1201 or the equivalent and MATH UN2010. Mathematical methods for economics. Quadratic forms, Hessian, implicit functions. Convex sets, convex functions. Optimization, constrained optimization, Kuhn-Tucker conditions. Elements of the calculus of variations and optimal control. (SC)

Spring 2024: MATH UN2500

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<tr>
<td>MATH 2500</td>
<td>001/12347</td>
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<td>Wenjian Liu</td>
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Fall 2024: MATH UN2500

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<th>Course Number</th>
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<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>MATH 2500</td>
<td>001/11875</td>
<td>M W 4:10pm - 5:25pm</td>
<td>Qiao He</td>
<td>3.00</td>
<td>64/64</td>
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<tr>
<td>MATH 2500</td>
<td>002/11876</td>
<td>T Th 10:10am - 11:25am</td>
<td>Roger Van Pešik</td>
<td>3.00</td>
<td>68/75</td>
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MATH UN3007 COMPLEX VARIABLES. 3.00 points.
Prerequisites: MATH UN1202 An elementary course in functions of a complex variable.
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 2024: MATH UN3007

<table>
<thead>
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<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
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<td>MATH 3007</td>
<td>001/11877</td>
<td>T Th 11:40am - 12:55pm</td>
<td>Ovidiu Savin</td>
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MATH UN3020 NUMBER THEORY AND CRYPTOGRAPHY. 3.00 points.
Prerequisites: one year of calculus.
Prerequisites: one year of calculus. Prerequisite: One year of Calculus. Congruences. Primitive roots. Quadratic residues. Contemporary applications

Spring 2024: MATH UN3020

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<th>Enrollment</th>
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<tr>
<td>MATH 3020</td>
<td>001/12358</td>
<td>M W 10:10am - 11:25am</td>
<td>Yoonjoo Kim</td>
<td>3.00</td>
<td>78/100</td>
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MATH UN3025 MAKING, BREAKING CODES. 3.00 points.
Prerequisites: (MATH UN1101 and MATH UN1102 and MATH UN1201) and and MATH UN2010.
Prerequisites: (MATH UN1101 and MATH UN1102 and MATH UN1201) and and MATH UN2010. A concrete introduction to abstract algebra.Topics in abstract algebra used in cryptography and coding theory

Fall 2024: MATH UN3025

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<th>Enrollment</th>
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<tr>
<td>MATH 3025</td>
<td>001/11878</td>
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<td>Dorian Goldfeld</td>
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MATH UN3027 Ordinary Differential Equations. 3 points.
Prerequisites: MATH UN1102 and MATH UN1201 or the equivalent.
Corequisites: MATH UN2010

MATH UN3028 PARTIAL DIFFERENTIAL EQUATIONS. 3.00 points.
Prerequisites: MATH UN3027 and MATH UN2010 or the equivalent
Prerequisites: (MATH UN2010 and MATH UN2030) or the equivalent introduction to partial differential equations. First-order equations. Linear second-order equations; separation of variables, solution by series expansions. Boundary value problems

Spring 2024: MATH UN3028

<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 3028</td>
<td>001/12359</td>
<td>T Th 1:10pm - 2:25pm</td>
<td>Simon Brendle</td>
<td>3.00</td>
<td>59/100</td>
</tr>
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</table>

MATH UN3050 DISCRETE TIME MODELS IN FINANC. 3.00 points.
Prerequisites: (MATH UN1102 and MATH UN1201) or (MATH UN1101 and MATH UN1102 and MATH UN1201) and MATH UN2010 Recommended: MATH UN3027 (or MATH UN2030 and SIEO W3600).
Prerequisites: (MATH UN1102 and MATH UN1201) or (MATH UN1101 and MATH UN1102 and MATH UN1201) 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 2024: MATH UN3050

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>MATH 3050</td>
<td>001/12360</td>
<td>M W 6:10pm - 7:25pm</td>
<td>Mikhail Smirnov</td>
<td>3.00</td>
<td>57/64</td>
</tr>
</tbody>
</table>

MATH UN3386 DIFFERENTIAL GEOMETRY. 3.00 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.

MATH UN3901 SUPERVISED READINGS I. 1.00-3.00 points.
Prerequisites: The written permission of the faculty 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. Supervising Readings do NOT count towards major requirements, with the exception of an advanced written approval by the DUS

Fall 2024: MATH UN3901

<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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</thead>
<tbody>
<tr>
<td>MATH 3901</td>
<td>001/00790</td>
<td></td>
<td>Dusa McDuff</td>
<td>1.00-3.00</td>
<td>0/5</td>
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<tr>
<td>MATH 3901</td>
<td>002/00791</td>
<td></td>
<td>Daniela De Silva</td>
<td>1.00-3.00</td>
<td>0/5</td>
</tr>
</tbody>
</table>
MATH UN3902 SUPERVISED READINGS II. 1.00-3.00 points.
Prerequisites: The written permission of the faculty 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. Supervising Readings do NOT count towards major requirements, with the exception of an advanced written approval by the DUS.

Spring 2024: MATH UN3902

<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 3902</td>
<td>001/18557</td>
<td></td>
<td>Julien Dubedat</td>
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<td>MATH 3902</td>
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<td>Amadou Bah</td>
<td>1.00-3.00</td>
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<tr>
<td>MATH 3902</td>
<td>003/20734</td>
<td></td>
<td>Andrew</td>
<td>1.00-3.00</td>
<td>2/2</td>
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<tr>
<td>MATH 3902</td>
<td>004/20960</td>
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<td>Simon Brendle</td>
<td>1.00-3.00</td>
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<tr>
<td>MATH 3902</td>
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<td>Francesco Lin</td>
<td>1.00-3.00</td>
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<tr>
<td>MATH 3902</td>
<td>006/20991</td>
<td></td>
<td>Mu-Tao Wang</td>
<td>1.00-3.00</td>
<td>1/1</td>
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</tbody>
</table>

MATH UN3951 UNDERGRADUATE SEMINARS I. 3.00 points.
Prerequisites: Two years of calculus, at least one year of additional mathematics courses, and the director of undergraduate studies’ permission.

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 2024: MATH UN3951

<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 3951</td>
<td>001/00007</td>
<td></td>
<td>Cristian Iovanov</td>
<td>3.00</td>
<td>47/64</td>
</tr>
</tbody>
</table>

MATH UN3952 UNDERGRADUATE SEMINARS II. 3.00 points.
Prerequisites: two years of calculus, at least one year of additional mathematics courses, and the director of undergraduate studies’ permission.

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 2024: MATH UN3952

<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 3952</td>
<td>001/00233</td>
<td></td>
<td>Alisa Knizel</td>
<td>3.00</td>
<td>61/80</td>
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</table>

MATH UN3997 SUPERVISED INDIVIDUAL RESEARCH. 1.00-4.00 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.

Spring 2024: MATH UN3997

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
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<tr>
<td>MATH 3997</td>
<td>001/00910</td>
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<td>Daniela De Silva</td>
<td>1.00-4.00</td>
<td>1/5</td>
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</table>

MATH UN3998 SUPERVISED INDIVIDUAL RESEARCH. 3.00 points.
Prerequisites: The written permission of the faculty member who agrees to act as a supervisor, and the permission of the Director of Undergraduate Studies. 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 GU4007 ANALYTIC NUMBER THEORY. 3.00 points.
Prerequisites: MATH UN3007

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 2024: MATH GU4007

<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 4007</td>
<td>001/12361</td>
<td>TTh 2:40pm - 3:55pm 307 Mathematics Building</td>
<td>Dorian Goldfeld</td>
<td>3.00</td>
<td>8/19</td>
</tr>
</tbody>
</table>

MATH GU4032 FOURIER ANALYSIS. 3.00 points.
Prerequisites: three terms of calculus and linear algebra or four terms of calculus.

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.

Fall 2024: MATH GU4032

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>MATH 4032</td>
<td>001/11879</td>
<td>T Th 10:10am - 11:25am Room TBA</td>
<td>Simon Brendle</td>
<td>3.00</td>
<td>42/49</td>
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</table>
MATH GU4041 INTRO MODERN ALGEBRA I. 3.00 points.
Prerequisites: MATH UN1102 and MATH UN1202 and MATH UN2010 or the equivalent.
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, normal subgroups, the isomorphism theorems, symmetric groups, group actions, the Sylow theorems, finitely generated abelian groups.

Fall 2024: MATH GU4041
Course Number | Section/Call Number | Times/Location | Instructor | Points | Enrollment |
--- | --- | --- | --- | --- | --- |
MATH 4041 | 001/12352 | M W 10:10am - 11:25am | Yao Xu | 3.00 | 55/64 |
MATH 4041 | 001/11904 | M W 1:10pm - 2:25pm | Robert Friedman | 3.00 | 89/100 |

MATH GU4042 INTRO MODERN ALGEBRA II. 3.00 points.
Prerequisites: MATH UN1102 and MATH UN1202 and MATH UN2010 or the equivalent.
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 2024: MATH GU4042
Course Number | Section/Call Number | Times/Location | Instructor | Points | Enrollment |
--- | --- | --- | --- | --- | --- |
MATH 4042 | 001/12353 | M W 2:40pm - 3:55pm | Konstantin Aleshkin | 3.00 | 43/64 |
MATH 4042 | 001/11846 | M W 10:10am - 11:25am | Michael Thaddeus | 3.00 | 31/49 |

MATH GU4043 ALGEBRAIC NUMBER THEORY. 3.00 points.
Prerequisites: MATH GU4041 and MATH GU4042 or the equivalent.
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.

Spring 2024: MATH GU4043
Course Number | Section/Call Number | Times/Location | Instructor | Points | Enrollment |
--- | --- | --- | --- | --- | --- |
MATH 4043 | 001/12364 | T Th 4:10pm - 5:25pm | Gyujin Oh | 3.00 | 8/20 |

MATH GU4044 REPRESENTATNS OF FINITE GROUPS. 3.00 points.
Prerequisites: MATH UN2010 and MATH GU4041 or the equivalent.
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 2024: MATH GU4044
Course Number | Section/Call Number | Times/Location | Instructor | Points | Enrollment |
--- | --- | --- | --- | --- | --- |
MATH 4044 | 001/11880 | T Th 1:10pm - 2:25pm | Andrei Okounkov | 3.00 | 27/30 |

MATH GU4045 ALGEBRAIC CURVES. 3.00 points.
Prerequisites: (MATH GU4041 and MATH GU4042) and MATH UN3007
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 2024: MATH GU4045
Course Number | Section/Call Number | Times/Location | Instructor | Points | Enrollment |
--- | --- | --- | --- | --- | --- |
MATH 4045 | 001/12366 | M W 2:40pm - 3:55pm | Nathan Chen | 3.00 | 5/20 |

MATH W4046 Introduction to Category Theory. 3 points.
CC/GS: Partial Fulfillment of Science Requirement
Not offered during 2023-2024 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. 3.00 points.
Prerequisites: (MATH UN1202 and MATH UN2010) and rudiments of group theory (e.g., MATH GU4041). 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 2024: MATH GU4051
Course Number | Section/Call Number | Times/Location | Instructor | Points | Enrollment |
--- | --- | --- | --- | --- | --- |
MATH 4051 | 001/11881 | T Th 6:10pm - 7:25pm | Rostislav Akhmechet | 3.00 | 36/49 |
MATH GU4052 INTRODUCTION TO KNOT THEORY. 3.00 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.

Ascoli-Arzela theorem, Stone-Weierstrass theorem, series, continuity, differentiation, integration, uniform convergence, numbers, metric spaces, elements of general topology, sequences and the study of algebraic and geometric properties of knots in R^3, including but not limited to knot projections and Reidemeisters 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.

### Fall 2024: MATH GU4052

<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>
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<tr>
<td>MATH 4052</td>
<td>001/11882</td>
<td>M W 11:40am - 12:55pm Room TBA</td>
<td>Siddhi Krishna</td>
<td>3.00</td>
<td>9/20</td>
</tr>
</tbody>
</table>

MATH GU4053 INTRO TO ALGEBRAIC TOPOLOGY. 3.00 points.

Prerequisites: MATH UN2010 and MATH GU4041 and MATH GU4051

Ascoli-Arzela theorem, Stone-Weierstrass theorem, series, continuity, differentiation, integration, uniform convergence, numbers, metric spaces, elements of general topology, sequences and the study of algebraic and geometric properties of knots in R^3, including but not limited to knot projections and Reidemeisters 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.

### Fall 2024: MATH GU4053

<table>
<thead>
<tr>
<th>Course Number</th>
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<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>MATH 4053</td>
<td>001/12368</td>
<td>T Th 11:40am - 12:55pm 407 Mathematics Building</td>
<td>Lucy Yang</td>
<td>3.00</td>
<td>14/30</td>
</tr>
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</table>

MATH GU4061 INTRO MODERN ANALYSIS I. 3.00 points.

Prerequisites: MATH UN1202 or the equivalent, and MATH UN2010. The second term of this course may not be taken without the first.

Ascoli-Arzela theorem, Stone-Weierstrass theorem, series, continuity, differentiation, integration, uniform convergence, numbers, metric spaces, elements of general topology, sequences and the study of algebraic and geometric properties of knots in R^3, including but not limited to knot projections and Reidemeisters 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.

### Fall 2024: MATH GU4061

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>MATH 4051</td>
<td>001/12354</td>
<td>M W 11:10pm - 2:25pm 203 Mathematics Building</td>
<td>Ivan Corwin</td>
<td>3.00</td>
<td>55/110</td>
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MATH GU4052 INTRO MODERN ANALYSIS II. 3.00 points.

Prerequisites: MATH UN1202 or the equivalent, and MATH UN2010. The second term of this course may not be taken without the first.

Ascoli-Arzela theorem, Stone-Weierstrass theorem, series, continuity, differentiation, integration, uniform convergence, numbers, metric spaces, elements of general topology, sequences and the study of algebraic and geometric properties of knots in R^3, including but not limited to knot projections and Reidemeisters 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.

### Spring 2024: MATH GU4062

<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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</thead>
<tbody>
<tr>
<td>MATH 4062</td>
<td>001/12540</td>
<td>T Th 4:10pm - 5:25pm 417 Mathematics Building</td>
<td>Nikolaos Apostolakis</td>
<td>3.00</td>
<td>14/50</td>
</tr>
</tbody>
</table>

MATH GU4065 HONORS COMPLEX VARIABLES. 3.00 points.

Prerequisites: (MATH UN1207 and MATH UN1208) or MATH GU4061

Ascoli-Arzela theorem, Stone-Weierstrass theorem, series, continuity, differentiation, integration, uniform convergence, numbers, metric spaces, elements of general topology, sequences and the study of algebraic and geometric properties of knots in R^3, including but not limited to knot projections and Reidemeisters 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.

### Fall 2024: MATH GU4065

<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>
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<tr>
<td>MATH 4062</td>
<td>001/11883</td>
<td>M W 11:40am - 12:55pm Room TBA</td>
<td>Milind Hegde</td>
<td>3.00</td>
<td>25/49</td>
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</tbody>
</table>

MATH GU4071 Introduction to the Mathematics of Finance. 3 points.  
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: MATH UN1202 and MATH UN3027 and STAT W4150 and SEIO W4150, 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, Causchy integral formulae, Cauchy's integral formula, polars, 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 2024: MATH GU4071

<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 4061</td>
<td>001/12354</td>
<td>M W 11:10pm - 2:25pm 203 Mathematics Building</td>
<td>Ivan Corwin</td>
<td>3.00</td>
<td>55/110</td>
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</table>

MATH GU4081 INTRO-DIFFERENTIABLE MANIFOLDS. 3.00 points.

Prerequisites: (MATH GU4051 or MATH GU4061) and MATH UN2010

Ascoli-Arzela theorem, Stone-Weierstrass theorem, series, continuity, differentiation, integration, uniform convergence, numbers, metric spaces, elements of general topology, sequences and the study of algebraic and geometric properties of knots in R^3, including but not limited to knot projections and Reidemeisters 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.

### Spring 2024: MATH GU4081

<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 4081</td>
<td>001/00234</td>
<td>M W 10:10am - 11:25am L103 Diana Center</td>
<td>Dusa McDuff</td>
<td>3.00</td>
<td>17/40</td>
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</tbody>
</table>
MATH GU4155 PROBABILITY THEORY. 3.00 points.
Prerequisites: MATH GU4061 or MATH UN3007

Spring 2024: MATH GU4155
Course Number Section/Call Number Times/Location Instructor Points Enrollment
MATH 4155 001/12373 T Th 2:40pm - 3:55pm 510 Mathematics Building Ioannis Karatzas 3.00 27/49

Fall 2024: MATH GU4155
Course Number Section/Call Number Times/Location Instructor Points Enrollment
MATH 4155 001/11860 T Th 2:40pm - 3:55pm Room TBA Ivan Corwin 3.00 34/49

MATH GU4392 INTRO TO QUANTUM MECHANICS II. 3.00 points.
Continuation of GU4391. 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 to be accessible to students with no previous formal training in quantum theory. The role of symmetry, groups and representations will be stressed.

SIEO W3600 INTRO PROBABILITY/STATISTICS. 4.00 points.
SIEO W4150 INTRO-PROBABILITY # STATISTICS. 3.00 points.

Cross-Listed Courses

Computer Science

COMS S3251 Computational Linear Algebra. 3 points.
Not offered during 2023-2024 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.

Spring 2024: COMS W4203
Course Number Section/Call Number Times/Location Instructor Points Enrollment
COMS 4203 001/202497 W 7:00pm - 9:30pm 451 Computer Science Bldg Yihao Zhang 3 24/60

COMS W3203 DISCRETE MATHEMATICS. 4.00 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).

Spring 2024: COMS W3203
Course Number Section/Call Number Times/Location Instructor Points Enrollment
COMS 3203 001/12070 T Th 10:10am - 11:25am 301 Uris Hall Anasf Salleb-Aouissi 4.00 215/200
COMS 3203 002/12071 T Th 11:40am - 12:55pm 301 Uris Hall Anasf Salleb-Aouissi 4.00 207/200

Fall 2024: COMS W3203
Course Number Section/Call Number Times/Location Instructor Points Enrollment
COMS 3203 001/11935 M W 4:10pm - 5:25pm Room TBA Tony Dear 4.00 145/270

Industrial Engineering and Operations Research

CSOR E4010 GRAPH THEORY: COMBINATL VIEW. 3.00 points.
Lect: 3. Not offered during 2023-2024 academic year.
Prerequisites: Linear Algebra, or instructor's permission.
An introductory course in graph theory with emphasis on its combinatorial aspects. Basic definitions, and some fundamental topics in graph theory and its applications. Topics include trees and forests graph coloring, connectivity, matching theory and others.