COMBINATORICS AND OPTIMIZATION

This degree concentration differs from the BA in Mathematics without a concentration only in the Concentration Requirements.

Bachelor of Arts - Mathematics; Combinatorics & Optimization Concentration

College Humanities & Sciences

Degree Specific Credits: 67

Required Cumulative GPA: 2.0

Catalog Year: 2017-2018

Note: The degree specific credits are much lower for double-majors and for students completing an additional minor (in another subject): 41 credits for students completing a second major, and 46 credits for students completing a minor.

General Education Requirements

Information regarding these requirements can be found in the General Education Section (http://catalog.umt.edu/academics/general-education-requirements) of the catalog.

Summary

Mathematics Core Courses 23
Upper-Division Mathematics Requirement 23
Upper-Division Elective Courses
Upper-Division Elective Computer Labs
Science Requirement 18
Advanced College Writing Requirement (usually fulfilled with a course that counts towards the Upper-Division Mathematics Requirement)
Foreign Language/Computer Science Requirement 3
Requirements for the Combinatorics & Optimization Concentration (usually fulfilled with courses that count towards the Upper-Division Mathematics Requirement)
Combinatorics & Optimization Concentration: Core Courses
Combinatorics & Optimization Concentration: Elective Courses
Total Hours 67

Mathematics Core Courses

Rule: Take all of the following courses.

M 171 Calculus I 4
or M 181 Honors Calculus I
M 172 Calculus II 4
or M 182 Honors Calculus II
M 210 Introduction to Mathematical Software 3
M 221 Introduction to Linear Algebra 4
M 273 Multivariable Calculus 4
M 300 Undergraduate Mathematics Seminar 1
M 307 Introduction to Abstract Mathematics 3
Total Hours 23

Minimum Required Grade: C-

Upper-Division Mathematics Requirement

Rule: Take 23 credits in this category.

Note:
1. Students completing a minor (in another subject) need take only 20 credits.
2. Students completing a second major need take only 18 credits.

Minimum Required Grade: C-

Upper-Division Elective Courses

Note:
1. Students completing a minor (in another subject) or a second major need take only 6 courses (totaling 18 credits or more).
2. Residency Requirement: At least 4 of the courses in this category must be taken at UM-Missoula (only 3 if M 307 is taken at UM-Missoula).
3. Note that STAT 451 does not count toward this requirement.

Take 7 courses from the following list; at least 3 of them must be at the 400 level:

M 301 Mathematics Technology for Teachers
M 311 Ordinary Differential Equations and Systems
M 325 Discrete Mathematics
M 326 Number Theory
M 361 Discrete Optimization
M 362 Linear Optimization
M 381 Advanced Calculus I
M 412 Partial Differential Equations
M 414 Deterministic Models
M 429 History of Mathematics
M 431 Abstract Algebra I
M 432 Abstract Algebra II
M 439 Euclidean and Non-Euclidean Geometry
M 440 Numerical Analysis
M 445 Statistical, Dynamical, and Computational Modeling
M 461 Practical Big Data Analytics
M 462 Theoretical Basics of Big Data Analytics and Real Time Computation Algorithms
M 472 Introduction to Complex Analysis
M 473 Introduction to Real Analysis
M 485 Graph Theory
STAT 341 Introduction to Probability and Statistics
STAT 421 Probability Theory
STAT 422  Mathematical Statistics
STAT 452  Statistical Methods II

Minimum Required Grade: C-

Upper-Division Elective Computer Labs
Rule: Computer labs from the following list are optional; if taken (0-2 credits), they count toward the total number of credits required for the Upper-Division Mathematics Requirement.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 317</td>
<td>Ordinary Differential Equations Computer Lab</td>
<td>1</td>
</tr>
<tr>
<td>M 363</td>
<td>Linear Optimization Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>M 418</td>
<td>Partial Differential Equations Computer Lab</td>
<td>1</td>
</tr>
<tr>
<td>STAT 457</td>
<td>Computer Data Analysis I</td>
<td>1</td>
</tr>
<tr>
<td>STAT 458</td>
<td>Computer Data Analysis II</td>
<td>1</td>
</tr>
</tbody>
</table>

Minimum Required Grade: C-

Science Requirement
Rule: Take 18 credits in at most 3 areas selected from astronomy (ASTR), biology (BIO*), chemistry (CHMY), computer science (CSCI, except CSCI TR*), economics (ECNS), forestry (FORS, WILD), geosciences (GEO), management information systems (BMIS), and physics (PHSX).

Note:
1. Students completing a minor in another subject or a second major are exempt from this requirement.
2. Transfer courses listed on the transcript as "CSCI TR*" may include course work in other areas such as Computer Applications (CAPP) and therefore do not count towards this requirement unless a student successfully petitions the Department of Mathematical Sciences.

Minimum Required Grade: C-
18 Total Credits Required

Advanced College Writing Requirement
Rule: Take 1 of the following 2 courses, or any other approved Advanced College Writing course.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 429</td>
<td>History of Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>or M 499</td>
<td>Senior Thesis</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 3
Minimum Required Grade: C-

Foreign Language/Computer Science Requirement
Rule: Either complete the General Education Requirement "Group III: Modern and Classical Language" (not the symbolic systems exception), or take one course from the following list.

Note: Students completing a second major are exempt from this requirement.

Select one of the following: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCI 100</td>
<td>Intro to Programming</td>
<td></td>
</tr>
<tr>
<td>CSCI 135</td>
<td>Fund of Computer Science I</td>
<td></td>
</tr>
<tr>
<td>CSCI 136</td>
<td>Fund of Computer Science II</td>
<td></td>
</tr>
<tr>
<td>CSCI 250</td>
<td>Computer Mdlng/Science Majors</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 3
Minimum Required Grade: C-

Requirements for the Combinatorics & Optimization Concentration
Minimum Required Grade: C-
12-13 Total Credits Required

Combinatorics & Optimization Option: Core Courses
Rule: Take all of the following courses.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 361</td>
<td>Discrete Optimization</td>
<td>3</td>
</tr>
<tr>
<td>M 362</td>
<td>Linear Optimization</td>
<td>3</td>
</tr>
<tr>
<td>M 485</td>
<td>Graph Theory</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Hours 9
Minimum Required Grade: C-

Combinatorics & Optimization Concentration: Elective Courses
Select one of the following: 3-4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCI 332</td>
<td>Design/Analysis of Algorithms</td>
<td></td>
</tr>
<tr>
<td>M 414</td>
<td>Deterministic Models</td>
<td></td>
</tr>
<tr>
<td>M 440</td>
<td>Numerical Analysis</td>
<td></td>
</tr>
<tr>
<td>STAT 341</td>
<td>Introduction to Probability and Statistics</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 3-4
Minimum Required Grade: C-

GPA Requirement
Note:
1. A cumulative GPA of 2.0 is required for all courses used to fulfill major requirements.
2. In addition, a cumulative GPA of 2.0 is required for all mathematical sciences courses used to fulfill major requirements. (Mathematical sciences courses are those with a prefix of M or STAT.)