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
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)
Total Hours 67

Mathematics Core Courses

Rule: Take all of the following courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 171</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>or M 181</td>
<td>Honors Calculus I</td>
<td></td>
</tr>
<tr>
<td>M 172</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>or M 182</td>
<td>Honors Calculus II</td>
<td></td>
</tr>
<tr>
<td>M 210</td>
<td>Introduction to Mathematical Software</td>
<td>3</td>
</tr>
<tr>
<td>M 221</td>
<td>Introduction to Linear Algebra</td>
<td>4</td>
</tr>
</tbody>
</table>

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:

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

M 317 Ordinary Differential Equations Computer Lab 1
M 363 Linear Optimization Laboratory 1
M 418 Partial Differential Equations Computer Lab 1
STAT 457 Computer Data Analysis I 1
STAT 458 Computer Data Analysis II 1

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.

M 429 History of Mathematics 3
or M 499 Senior Thesis

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
CSCI 100 Intro to Programming
CSCI 135 Fund of Computer Science I
CSCI 136 Fund of Computer Science II
CSCI 250 Computer Mdlng/Science Majors

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.

M 361 Discrete Optimization 3
M 362 Linear Optimization 3
M 485 Graph Theory 3

Total Hours 9
Minimum Required Grade: C-

Combinatorics & Optimization Concentration: Elective Courses
Select one of the following: 3-4
CSCI 332 Design/Analysis of Algorithms
M 414 Deterministic Models
M 440 Numerical Analysis
STAT 341 Introduction to Probability and Statistics

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.)

Minimum Required Grade: C-