UNIVERSITY OF MONTANA

Department of Mathematical Sciences

# M 361
# Discrete Optimization

**Course:** M 361 Sec. 01 (CRN 34078) 3 cr., Spring 2019
Discrete Optimization
TΘ 9:30–10:50am in MATH 312


**Instructor:** Mark Kayll **Econtact:** mark.kayll@umontana.edu
hs.umt.edu/math/people/default.php?s=Kayll

**Office:** MATH 209
406.243.2403


**Hours:** T 1:30–2:20pm, Th 12:40–1:30pm & by appointment
(*tentative*) (open for all course matters, including DSS accomm.)

**Prerequisites:** one of M 162 (Applied Calculus), M 172 (Calculus II) or M 182 (Honors Calculus II);
M 221 (Intro Linear Algebra) or M 225 (Intro Discrete Math) are recommended;
or consent of instructor.
Students should have background appropriate for junior-level mathematical studies. Though assignments will not be completely theoretical, some homework problems will ask for proofs.

**Text:** *Discrete Mathematics: Elementary and Beyond*, L. Lovász, J. Pelikán, and K. Vesztergombi, Springer, 2003 [ISBN-13: 978-0-387-21777-2]

**Important Dates:**

| | |
|---|---|
| last day to add w/o override | Friday, 18 January (5pm); |
| Martin Luther King, Jr. Day holiday | Monday, 21 January (5pm); |
| last day to drop by Cyberbear, or select Audit grade option | Thursday, 31 January (5pm); |
| Presidents' Day holiday | Monday, 18 February; |
| last day to add/drop by Workflow | Friday, 15 March (5pm); |
| spring break | 25–29 March; |
| Math Awareness Month | April (watch for events); |
| last day to add/drop through Dean | Friday, 26 April (5pm); |
| last class meeting (during finals) | Tuesday, 30 April 8:00–10:00am. |

**Description:** How many ways can you arrange your math textbooks on a shelf? How about *rearrange* them (none in its original spot)? How many ways can the billiard balls in a game of eight-ball wind up in the pockets? How about snooker? How can you use graph theory to sequence RNA chains? Or efficiently deliver the mail? These sorts of questions fall into the realm of ***discrete mathematics***. M 361 introduces the techniques of discrete optimization, namely understanding and optimizing discrete structures. It's intended for both mathematics and non-mathematics majors. For background, we begin with a study of elementary discrete mathematics, that is, basic combinatorics and graph theory. In the latter half of the course, we consider various applications such as graph algorithms, minimum spanning trees, matching, and other related topics. Against the backdrop of the lectures, that steer the course, students can expect to gain some facility for the topics covered through working exercises and problems.

**Learning outcomes:** The 'official' outcomes below are reflected in the description above.

- Demonstrate the techniques of discrete optimization and their applications;
- Explain applications such as graph algorithms, minimum spanning trees, graph coloring, and matching theory;
- Develop appropriate mathematical models for 'real-world' problems and find solutions using the techniques above.

**Assessment:** Course grades will be based on homework assignments, two term tests and a final exam. Traditional letter grades will be assigned using the +/− system (see *UM catalog* at catalog.umt.edu/academics/policies-procedures/). UM's policy on Incomplete grades will be followed (see *UM catalog*).

(over)

**Homework** Assignments will be set regularly, roughly every two weeks. A (possibly improper) subset of the assigned problems will be graded. Homework is submitted electronically on `gradescope.com`, either in PDF or JPG format from your device. The course number is **36005**, with Entry Code **9B2ZYG**. You'll receive an email invite at your official UM email address; follow the instructions to link to `Gradescope` and get started. Students are responsible for compiling their own 'solution sets', comprised of their own submissions, augmented by notes from meetings with other students and with the instructor.

I urge you from the outset to get into the habit of staying on schedule with your reading and homework. This will help you to maximize the material you're able to absorb in class, meaning less effort in preparing for tests.

***Tentative* grading schedule**

| Item | Date(s) | Weight |
|---|---|---|
| Homework | 10 January — 25 April | 20% |
| Test # 1 | Tuesday, 12 February | 20% |
| Test # 2 | Thursday, 14 March | 20% |
| Final exam | Tuesday, 30 April 8:00–10:00am | 40% |

**Accommodation:** The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. If you have a disability that adversely affects your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or 406.243.2243. The instructor will work with you and Disability Services to provide an appropriate modification.

## General Remarks

**On homework:** Please use complete sentences, proofread, and polish your work prior to submission. You're encouraged to type homework solutions unless your handwriting is clear. You may work with others on homework problems, and you're encouraged to do so.

**Solutions should be written down privately in your own words.**

If you use an important idea of someone else, then please acknowledge that person by giving an appropriate citation in your write-up. This professional courtesy will not affect your grade.

**On exams:** As noted above, there are two in-class tests and a final exam. The latter will be cumulative with a slight emphasis on the material not covered by the in-class tests.

**On make-ups:** Make-ups for tests will *not* be given unless there is a valid excuse cleared with the instructor *prior* to the test. Since at least the most detrimental assignment is dropped, there are no homework make-ups.

**On deadlines:** Any stated deadlines will be firm; please don't ask for extensions.

**On electronic devices:** Cell phones must be silenced during class meetings and visits to my office. Use of a cell phone during a test for any purpose other than as a calculator is grounds for earning a zero score on that test.

**On conduct:** All students need to be familiar with the Student Conduct Code; it can be found in the 'A to Z Index' on the UM home page. All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the university.

## Additional References

1. E.G. Goodaire and M.M. Parmenter, *Discrete Mathematics with Graph Theory, 3rd edition*, Pearson Prentice Hall, Upper Saddle River NJ, 2006
2. J. Matoušek and J. Nešetřil, *Invitation to Discrete Mathematics*, Oxford, New York, 1998
3. F.S. Roberts and B. Tesman, *Applied Combinatorics, 2nd edition*, Prentice-Hall, Upper Saddle River, 2005

Combinatorics is the most fundamental, and hence the most important, branch of mathematics, since it deals with FINITE structures, and the world is finite.
Doron Zeilberger, *Board of Governors Professor of Mathematics*
Rutgers University