UNIVERSITY OF MONTANA

Department of Mathematical Sciences

M 581 Combinatorics

Course: M 581 Sec. 01 (CRN 74502) 3 cr., Autumn 2017
Combinatorics
TΘ 9:30–10:50am in MATH 108

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

Office: MATH 209
406.243.2403

Hours: M 2:00–2:50pm, Θ 12:20–1:10pm & by appointment
(*tentative*) (open for all course matters, including DSS accomm.)

Prerequisites: students should have background suitable for graduate-level mathematical studies; combinatorial ideas will be introduced as needed. No specific combinatorial background is assumed.

Text: Douglas B. West, *Combinatorial Mathematics*, manuscript for forthcoming textbook, 2017 (≈ $50)

Important Dates:

Labor Day Holiday	Monday, 4 September;
last day to add by Cyberbear	Monday, 11 September (5pm);
last day to drop by Cyberbear, or select Audit grade option	Thursday, 21 September (5pm);
last day to add/drop by paper form	Thursday, 2 November (5pm);
Veterans' Day Holiday	Friday, 10 November;
Thanksgiving vacation	22–24 November;
last day to add/drop by petition	Tuesday, 12 December (5pm);
last class meeting (during finals)	Thursday, 14 December 10:10am–12:10pm.

Description: This is an introduction to and survey of combinatorics at the graduate level. Concepts will be introduced from scratch but considered in some depth. Combinatorics is a subject that offers easily stated problems, the solutions of which often lead one to delve into a myriad of 'mathematical tool boxes'. One who studies the subject is thus afforded the opportunity to learn about many branches of mathematics. Students seeking thesis problems might wish to consider that combinatorics is also a very active field of research. Also, students preparing for graduate exams in C&O will benefit from taking this course.

Topics will be selected from the following (non-exhaustive) list: extremal set theory, Ramsey theory, combinatorial designs, error-correcting codes, graph colorings, matching theory, partially ordered sets, correlation inequalities (e.g. the 'four functions theorem'), infinite combinatorics. 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. The presentations enrich the course content for the audience and lay a more solid foundation in the selected material for the speaker.

Assessment: Grades are based on performance on homework and a presentation. There will be up to two (but maybe zero) take-home tests to be counted as part of the HW weight (see below). There are zero in-class tests. 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*).

Homework: Assignments are set regularly, roughly every ten calendar days. A (possibly proper) subset of the assigned problems will be graded. 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.

(over)

Presentations: Each presentation consists of a 50-minute lecture scheduled during a regular, or final, class meeting. The content of the presentations should be related to the course content and may be inspired by one or more sections of the text, by related paper(s), or by other related material. Students should schedule their lecture date privately with the instructor early in the semester; time slots are assigned on a first-come, first-served basis. Lecture topics must be approved by the instructor, and students should take the following preparatory steps.

Step	Timing	Action
0	early in semester	Schedule lecture date with instructor.
1	3 weeks prior to lecture	Submit a $\leq$ 1-page typed summary proposal of lecture topic, with references.
2	2 weeks prior to lecture	Receive proposal approval or suggested modifications from instructor.
3	1 week prior to lecture	Meet with instructor privately for final informal discussion of lecture topic; be prepared to field questions.

The following weights will be used to determine course grades:

Homework/take-home tests	70%;
Presentation	30%.

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 course homework, and you are encouraged to do so; however,

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 make-ups: Since at least your most detrimental assignment is dropped, there are no homework make-ups.

On deadlines: Any stated deadlines are firm; please do not ask for extensions. (Violating this policy is grounds for points subtracted from the corresponding assignment.)

On electronic devices: Cell phones must be silenced during class meetings and office hour visits.

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. B. Bollobás, *Combinatorics: Set Systems, Hypergraphs, Families of Vectors, and Combinatorial Probability*, Cambridge University Press, 1986
2. P.J. Cameron, *Combinatorics: Topics, Techniques, Algorithms*, Cambridge University Press, 1994
3. J.H. van Lint and R.M. Wilson, *A Course in Combinatorics, 2e*, Cambridge University Press, 2001
4. L. Lovász, *Combinatorial Problems and Exercises*, North-Holland, 1993

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