Spring 2-1-2018

M 584.01: Topics in Combinatorics and Optimization

Mark Kayll
University of Montana, Missoula, mark.kayll@umontana.edu

UNIVERSITY OF MONTANA

Department of Mathematical Sciences

M 584
Combinatorics II

Course: M 584 Sec. 01 (CRN 37597) 3 cr., Spring 2018
Topics in C & O: Combinatorics II
TΘ 9:30–10:50am in MATH 211

Instructor: Mark Kayll
Office: MATH 209
406.243.2403

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

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

Prerequisites: background for graduate-level mathematics. Additionally, it's desirable to have *some* prior exposure to discrete mathematics, as might be gained from M 485 (Graph Theory) or M 581 (Combinatorics). Students excelling in M 361 (Discrete Optimization) or M 325 (Discrete Mathematics) should also be prepared for this course.

Text: D.B. West, *Combinatorial Mathematics*, Manuscript for forthcoming textbook, 2017

Important Dates:

last day to add w/o Override	Tuesday, 30 January (5pm);
last day to drop by Cyberbear, or select Audit grade option	Friday, 9 February (5pm);
Presidents' Day holiday	Monday, 19 February;
spring break	26–30 March;
Math Awareness Month	April (watch for events);
last day to add/drop by paper form	Monday, 2 April (5pm);
last day to add/drop through Dean	Friday, 4 May (5pm);
last class meeting (during finals)	Tuesday, 8 May 8:00–10:00am.

Description: This course samples and surveys graduate-level combinatorics. An alternate, more whimsical, title could be: ***"Everything you wanted in your first graduate combinatorics[1] course if it had just been twice as long"***. Topics will more deeply probe combinatorial theory under headings introduced in UM's M 581 (Combinatorics) but limited by time. Students who didn't take M 581 need not fear—the instructor will provide refreshers on earlier concepts and results as needed.

Combinatorics II topics will be selected from the following (non-exhaustive) list: extremal set theory (Kruskal-Katona Theorem, LYM Inequality), Ramsey theory (Schur's and van der Waerden's Theorems), graph and hypergraph coloring, combinatorial designs, matching theory, partially ordered sets, correlation inequalities (the 'Four Functions Theorem'), and infinite combinatorics.

(over)

Assessment: Grades are based on performance on items to be discussed in class, e.g., attendance, homework, and a presentation (not exams). 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: Details will be discussed in class.

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.

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; 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: There are no homework make-ups; this policy will be elaborated in class.

On deadlines: Any stated deadlines are firm; please do not ask for extensions. (Violating this request is considered grounds for a penalty on 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 (reprinted 1990)
2. J.A. Bondy and U.S.R. Murty, *Graph Theory*, Springer, 2008
3. R.L. Graham, B.L. Rothschild, and J.H. Spencer, *Ramsey Theory*, 2e, Wiley, 1990

[1]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