MA 514
Combinatorial Structures and Techniques
Fall 2014
MWF 12:00–12:50 — CB 347

Instructor: Carl Lee.

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Email: lee@ms.uky.edu (preferred method for reaching me).

Phone: 257-1405 (or 257-3336 to leave a message).

Office Hours: MWF 9:00-9:50, and by appointment, since I realize that this time may not be convenient for everyone.

Course Web Page: I will post materials here: `http://www.ms.uky.edu/~lee/ma514fa14/ma514fa14.html`.

Text: J.H. van Lint and R.M. Wilson, *A Course in Combinatorics*, second edition, Cambridge University Press, 2001, ISBN-10: 0521006015, ISBN-13: 978-0521006019. But be aware that some of the second editions differ a little bit, especially with respect to problem numbering.

Course Description: An introduction to fundamental structures and techniques in combinatorics, including such topics as graphs, trees, colorings of graphs, extremal graphs, bipartite matchings, partially ordered sets, extremal set theory, flows in networks, and the principle of inclusion/exclusion. Prereq: MA 322 and one additional upper division mathematics course, or consent of instructor.

Course Objectives: Content: Introduce combinatorial structures and techniques that are foundational and widely used. Practice: Increase experience with the mathematical habits of mind, such as analyzing and illustrating definitions and theorems, testing hypotheses, solving problems and proving theorems, seeking and understanding underlying unifying patterns, and communicating mathematics effectively.

Learning Outcomes: Students will demonstrate knowledge of fundamental structures and techniques in combinatorics. Students will solve problems and prove theorems using these structures and techniques.

Course Schedule:

1. Graphs. Terminology of graphs and digraphs, Eulerian circuits, Hamiltonian circuits. (Chapter 1 of text.)
2. Trees. Cayley's theorem, spanning trees and the greedy algorithm, search trees, strong connectivity. (Chapter 2.)
3. Colorings of graphs and Ramsey's theorem. Brooks' theorem, Ramsey's theorem and Ramsey numbers, the Lovász sieve, the Erdős-Szekeres theorem. (Chapter 3.)
4. Turán's theorem and extremal graph theory. (Chapter 4.)
5. Systems of distinct representatives. Bipartite graphs, Hall's condition, SDRs, König's theorem, Birkhoff's theorem. (Chapter 5.)
6. Dilworth's theorem and extremal set theory. Partially ordered sets, Dilworth's theorem, Sperner's theorem, symmetric chains, the Erdős-Ko-Rado theorem. (Chapter 6.)
7. Flows in networks. The Ford-Fulkerson theorem, the integrality theorem, a generalization of Birkhoff's theorem, circulations. (Chapter 7.)
8. The principle of inclusion and exclusion. (Chapter 10.)
9. Other material as time permits.

Attendance and Participation: Attendance is expected. This class is designed for active involvement of the students. You will be actively supporting each other as you gain experience and understanding. Multiple ideas and points of view are important. You will benefit from hearing others' approaches to analysis and problem solving, and they will benefit from you. So attendance and active participation are expected. I expect activities in class to be related to the course. In particular, cellphones should be silenced, and use of laptops and other electronic devices should be devoted to the course activities.

If you miss a class for any reason, please let me know the reason immediately—an email message will suffice. I will give you an opportunity to make up graded work missed due to an excused absence.

S.R. 5.2.4.2, `http://www.uky.edu/StudentAffairs/Code/part2.html`), defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Information regarding dates of major religious holidays may be obtained through the religious liaison, Mr. Jake Karnes (859-257-2754).

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused or unexcused) per university policy.

Students may be asked to verify their absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request "appropriate verification" when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence.

Homework: There will be frequent homework assignments, usually assigned weekly, with specified due dates. The homework problems will have varying length and complexity. Some homework might actually be classwork collected in class. It is expected that you regularly read in detail the relevant sections in the textbook and complete all assigned work. It is fine to discuss the homework together, but you must write up your own solutions in your own words.

Exams: There will be two exams during the semester and a final exam. Tentative exam dates: Wednesday, October 1, and Wednesday, November 5.

Final Exam: Wednesday, December 17, 10:30 am to 12:30 pm, in our regular classroom, though part or all of this exam might be take-home.

Grading Policy: The two exams and the final exam will each contain two parts: (1) questions that are to be answered by all students; and (2) questions that are to be answered

by graduate students only. In addition, selected homework assignments will similarly have two such parts.

Your course score will be based on on the following percentages:

50%	Homework
30%	In-Class Exams
20%	Final Exam

If you are an undergraduate student, your letter grade will be determined according to the standard 10% scale:

90–100%	A
80–89%	B
70–79%	C
60–69%	D
0–59%	E

If you are a graduate student, your letter grade will be determined according to the scale:

90–100%	A
80–89%	B
70–79%	C
0–69%	E

Academic Integrity: Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: `http://www.uky.edu/Ombud`. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Part II of Student Rights and Responsibilities (available online `http://www.uky.edu/StudentAffairs/Code/part2.html`) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about the question of plagiarism involving their own work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording or anything else from another source without appropriate acknowledgment of the fact, the students are guilty of plagiarism. Plagiarism includes reproducing someone else's work, whether it be a published article, chapter of a book, a paper from a friend or some file, or something similar to this. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work which a student submits as his/her own, whoever that other person may be.

Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone. When a student's assignment involves research in outside sources of information, the student must carefully acknowledge exactly what, where and how he/she employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas which are so generally and freely circulated as to be a part of the public domain (Section 6.3.1).

Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.

Accommodations Due to Disability: If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address: jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

Suggestions and Other Course Issues: Suggestions for improvement are welcome at any time. Any concern about the course should be brought first to my attention. Further recourse is available through the offices of the Mathematics Director of Undergraduate Studies, the

Director of Graduate Studies, and the Department Chair, all accessible from the Main Office in 715 Patterson Office Tower.

Some Dates:

August 27 — Wednesday — First day of class

September 1 — Monday — Labor Day — Academic Holiday

October 20 — Monday — Midpoint of 2010 Fall Semester

November 26—29 — Wednesday through Saturday — Thanksgiving — Academic Holidays

December 12 — Friday — Last day of class

December 17 — Wednesday — Final exam, 10:30 am –12:30 pm, in our regular room