Math 614 Enumerative Combinatorics Spring 2023

Professor Margaret Readdy
825 Patterson Office Tower
phone: 859-257-4680
margaret.readdy@uky.edu

Lectures MWF noon, CB 307
Office Hours: By appointment and via Zoom
http://www.ms.uky.edu/~readdy/614

Text

Prerequisite
Math 565 or permission of instructor.

Material
An introduction to the basic notions and techniques in enumerative combinatorics. Topics include generating functions, principle of inclusion and exclusion, bijections, recurrence relations, partially ordered sets, the Möbius function and Möbius algebra, Lagrange inversion formula, the exponential formula and tree enumeration.

The material has applications to active areas of research including polytopal theory, hyperplane arrangements, computational commutative algebra, representation theory, symmetric functions, Coxeter groups and topology.

This is the second semester course in the Discrete Mathematics prelim sequence. Note that you can take Math 514 and 614 in any order.

Course Outline

I. Generating Functions.
   II. Stirling Numbers of the First and Second Kind.
   III. Permutations and Permutation Statistics.
   IV. $q$-analogues.
   V. The Twelvefold Way.
   VI. Exponential Generating Functions.*
   VII. The Exponential Formula.*
   VIII. Tree Enumeration.*
   IX. Lagrange Inversion Formula.*
   X. Principle of Inclusion-Exclusion.
   XI. Partially Ordered Sets and Lattices.
   XII. The Fundamental Theorem of Distributive Lattices.
   XIII. The Incidence Algebra.
   XIV. The Möbius Inversion Formula.
   XV. The Möbius Function and Computational Techniques.
XVI. The Möbius Algebra.
XVII. Semi-modular Lattices and Hyperplane Arrangements.
XVIII. The Zeta Polynomial.
XIX. Rank-selection.
XX. R-labelings.
XXI. Eulerian Posets.
XXII. Binomial Posets.
XXIII. Other topics (symmetric chain decomposition, symmetric functions, .. ), as time permits.

* Chapter 5 in EC II.

Homework
One problem will be posed during each lecture and is due at the start of the next lecture. **No late homework will be accepted.** Solutions should be written in complete sentences using correct English grammar and spelling, such as you would find in a mathematics textbook or journal article. Students may discuss the course material with other students in the course. Students *may not*, however, discuss the homework with anyone outside of the course other than the instructor. Internet searches for solutions are not permitted. Violations will be considered academic dishonesty. At a minimum, you will receive a zero for the assignment.

Midterm and Final Exams
The date of the midterm (in-class) will be announced two weeks before it occurs. The final exam will be in-class on Wednesday, May 3, 2023 from 1:00 pm – 3:00 pm. The final exam is cumulative.

Grading
Your course grade will be a weighted average of the letter grades on your homework, midterm and final exam. The distribution is as follows:

- 30% Homework
- 30% Midterm
- 40% Final Exam

Students are expected to attend all of the lectures. More than two unexcused absences will result in dropping your course grade by one letter grade.

References on Reserve


Absences
Faculty Senate Rule 5.2.4.2 defines acceptable reasons for excused absences to be: (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. As required by University rules, you must present full documentation in order to request makeup work for a valid absence. 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 or a major religious holiday is required no later than 7 days prior to the absence.

Cheating
Don’t do it. It is an extremely serious offense. As a minimum response, I will give a zero to the offender.

Devices
No digital devices of any kind (cellphones, computers, calculators, etc) are allowed during exams. By University policy the use of such constitutes cheating.

Laptops and/or cellphones are not allowed to be used at anytime in the classroom without the instructor’s prior consent.

Plagiarism
Plagiarism includes copying from outside sources, including internet sources. If charged, at minimum you will receive a zero. Maximum penalties include being suspended, dismissed or expelled from the University. For further information, consult the Faculty Senate rules.

Classroom Decorum
Code of Student Conduct (AR 4.10), Section V, Letter J, Instructional Setting Behavior:

“Students who engage in conduct that results in disruption of an instructional setting may be directed by the instructor to leave the class for the remainder of the instructional setting period.”

An attitude of respect for and civility towards other students in the class and the instructor is expected at all times. If what you are doing would be inappropriate behavior on a job interview, then it is very likely inappropriate behavior in the classroom. Students who violate classroom behavior standards during the lecture will be marked as an unexcused absence from that day’s attendance/work. Depending upon the severity of the disruption, the student will be asked to leave.

Intellectual Property
All course content, including, but not limited to handouts, assignments, live and recorded lectures, lecture notes, syllabus, review materials, exams and webpages, is the intellectual property of the instructor. The instructor is the exclusive owner of all course materials. Course content cannot be reproduced in any medium or sold without prior permission from the instructor.

Course meetings and lectures may be recorded by the instructor. All video and audio recordings of lecturers and class meetings, provided by the instructor, are for educational use by students in this class only. They are not to be copied, shared, uploaded to other online environments or
Photography & Recording
Video and/or audio recordings are not permitted unless a student has received prior permission from the instructor. Recording of other students by student(s) is prohibited per the UK Code of Student Conduct. Any distribution of recordings is also prohibited. Students with specific recording accommodations approved by the Disability Resource Center should present their official documentation to the instructor.

Any violation of the class photography & recording policies will result in your final course grade being reduced by one letter grade as a minimum penalty.

Students with Accomodations
Students with disabilities should provide your instructor with a Letter of Accommodation from the Disability Resource Center. The DRC can be reached via phone (859-257-2754) or email (drc@uky.edu).

The instructor reserves the right to modify this syllabus at any time.