Syllabus for (Graduate) Combinatorics I   **Fall 2023, Howard University**

Course #:	Math 273
Class time:	Mon-Wed-Fri, 12:10-1:00pm
Format:	Online - via Zoom

Instructor:	Sam Hopkins
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Office:	Annex III (Graduate School) - #220
Office Hours:	By appointment

Course content:	We'll study basic combinatorial objects (subsets, multisets, permutations, set/number partitions, compositions, graphs, trees, etc), their enumeration and additional structures they carry (such as partial orders).
Prerequisites:	Calculus, linear algebra, undergraduate algebra (groups, rings, fields)
Textbook:	R.P. Stanley, *Enumerative combinatorics*, Vol. I, 2nd ed.
	F. Ardila, *Algebraic & geometric methods in enumerative combinatorics*
	Problems come from Stanley, but the lectures more closely follow Ardila.

Grading:	There will be 3 homework assignments for the semester.
	The grading of the assignments will depend on both the quality and quantity of homework turned in. Beyond that, I expect you to show up to class and be engaged. Collaboration on the homework is encouraged, as long as each person understands the solutions, writes them up in their own words, and indicates with whom they collaborated.
	Problems will mostly be exercises from Stanley, plus some other problems I come up with.

Detailed outline:	Roughly speaking we will try to cover the following:

- Generating functions (ordinary and exponential)
- Basic objects:
    - integer partitions and compositions,
    - subsets and multisets,
    - Permutations,
    - set partitions,
    - the Catalan families
- The 12-fold way
- Combinatorial statistics and q-analogs:
    - q-binomial and q-multinomial coefficients,
    - permutation statistics (Mahonian and Eulerian)
- Counting with signs:
    - the principle of inclusion-exclusion,

- - sign-reversing involutions
- Determinantal/trace formulas:
  - matrix-tree theorem,
  - transfer matrix method
- Partially ordered sets and lattices:
  - distributive lattices, Birkhoff's Theorem,
  - Möbius functions and Möbius inversion

But if there are any topics you are especially interested in, please let me know! I am happy to tailor this course to the interests of the students.

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Academic Code of Student Conduct *(please see Howard University handbook)***:** No copying, unauthorized use of calculators, books, or other materials, or changing of answers or other academic dishonesty will be tolerated. Cheating will not be tolerated. Anyone caught cheating will receive an F for the course and may be expelled from the university.

Grievance Procedure: If you have any problems with the policies or rules of this course, discuss your concerns with your instructor. If you are still unable to come to a satisfactory arrangement, you may contact (depending on your status) the Director of Undergraduate Studies, Dr. Jill McGowan, jmcgowan@howard.edu, or the Director of Graduate Studies, Dr. Henok Mawi, henok.mawi@howard.edu, and then, finally, the Chair of the Department, Dr. Bourama Toni, bourama.toni@howard.edu.

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