Course Subject, Number and Title
MATH/COMP SCI/STAT 475 – Introduction to Combinatorics

Credits
3

Canvas Course URL
https://canvas.wisc.edu/courses/183804

Course Designations and Attributes
Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Meeting Time and Location
MWF 12:05PM - 12:55PM at INGRAHAM 120

Instructional Mode
Face-to-face

Credit hour expectations
This class meets for three 50-minute class period each week over the fall/spring semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc) for about 2 hours out of classroom for every class period. The syllabus includes additional information about meeting times and expectations for student work.

INSTRUCTORS AND TEACHING ASSISTANTS
Instructor Title and Name
Dr. Siddhesh Wagh

Instructor Availability
Office B127 Van Vleck Hall
T – 11:30AM – 12:00PM
W – 1:30PM – 2:30PM
F – 11:00AM – 12:00PM

Otherwise after class or by appointment.
OFFICIAL COURSE DESCRIPTION

Official Course Description

Enroll Info: None

Requisites
(MATH 320, 340, 341, or 375) or graduate/professional standing or member of the Pre-Masters Mathematics (Visiting International) Program

LEARNING OUTCOMES

Course Learning Outcomes

- Understand basic counting strategies, such as staged thought-experiments, inclusion/exclusion, generating functions, and recurrence relations, and apply these strategies to solve a wide variety of counting problems.
- Recall basic objects that are used in combinatorics, such as permutations and combinations of sets and multisets, binomial and multinomial coefficients, the Catalan numbers, the Stirling numbers, and the partition numbers.
- Analyze a given combinatorial problem using the standard theorems of combinatorics, such as the pigeonhole principle, the Newton binomial theorem, the multinomial theorem, the Ramsey theorem, the Dilworth theorem, the Burnside theorem, and the Polya counting theorem.
- Construct mathematical arguments related to combinatorial problems using the above definitions, properties, theorems, and counting strategies; including the construction of examples and counterexamples.
- Convey his or her arguments in oral and written form in English, using appropriate mathematical terminology, notation, and grammar.

GRADING

The following scores correspond to the guaranteed grades in this course. The scores may be lowered at the end of the semester by the instructor.

A ≥ 93% > AB ≥ 89% > B ≥ 82% > BC ≥ 78% > C ≥ 70% > D ≥ 60% > F

REQUIRED TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS

EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK
The course grade is based on two in-class exams and final exam, as well as homework. Each in-class exam is worth 100 points, and the final exam is worth 150 points. The graded homework is worth 50 points. Exams other than the final will be held in class during class times on the dates mentioned below. The final will be 2 hours long and held in a room that will be informed later during the semester.

Exam 1: Friday, March 6
Exam 2: Friday, April 17
Final: Sunday, May 3 2:45PM – 4:45PM

HOMEWORK & OTHER ASSIGNMENTS
- I will assign homework problems nearly every week that are to be turned in on Friday of that week.
- They will be graded by a grader assigned to me.

Course learning outcomes:
By the end of the course, the student should be able to solve the following 20 problems, and other problems of a similar nature.
- Each day a student walks from her home to school, which is located 10 blocks east and 14 blocks north from home. She always takes a shortest walk of 24 blocks. How many different walks are possible?
- Consider the set of integers from 1 to 20 inclusive. This set has how many 3-element subsets, such that no two consecutive integers are in the subset?
- Two red rooks and four blue rooks are placed on a 6-by-6 chessboard, so that no two rooks can attack each other. In how many ways can this be done?
- A bagel store sells six different kinds of bagels. Suppose you choose 16 bagels at random. What is the probability that your choice contains at least one bagel of each kind?
- Construct a permutation of 12345678 whose inversion sequence is 66142100.
- Compute the sum of the cubes of the first million positive integers.
- Find the number of integers between 1 and a million inclusive, that are not divisible by 4, 5, or 6.
- Find the number of integers between 1 and a million inclusive, that are neither perfect squares nor perfect cubes.
- How many ways are there to put 14 indistinguishable marbles into 4 distinguishable boxes?
- For each row of Pascal’s triangle, find the sum of the squares of the entries in that row.
- Find the number of permutations of 12345678 for which exactly three integers are in their natural position.
- At a party, seven gentlemen check their hats. In how many ways can their hats be returned, so that no gentleman receives his own hat?
• A subway has six stops on its route from its base location. There are 10 people on the subway as it departs its base location. Each person exits the subway at one of its six stops, and at each stop at least one person exits. In how many ways can this happen?
• Find the number of 1-by-100 chessboards for which the squares of the chessboard can be colored red, white, and blue so that no two squares colored red are adjacent.
• Find the number of 1-by-100 chessboards for which the squares of the chessboard can be colored red, blue, green, and orange such that an even number of squares are colored red and an even number are colored green.
• Find the exponential generating function for the sequence of cubes 0, 1, 8, 27, . . . 4
• Find the number of 100-digit integers with all digits odd, such that 1 and 3 each occur a nonzero, even number of times.
• Start with a set S with 100 elements. Consider the partially ordered set consisting of all subsets of S, with partial order by inclusion. What is the cardinality of the largest antichain in this partially ordered set?
• Choose 100 equally spaced points around a circle. Find the number of ways to join the 100 points in pairs, so that the resulting 50 line segments do not intersect.
• Find the number of different necklaces that contain eight red and ten blue beads.

RULES, RIGHTS & RESPONSIBILITIES
• To see the Guide’s Rules, Rights and Responsibilities information, refer to http://guide.wisc.edu/undergraduate/#rulesrightsandresponsibilities.

ACADEMIC INTEGRITY
By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison’s community of scholars in which everyone’s academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES
McBurney Disability Resource Center syllabus statement: “The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to
identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.” [http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php](http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php)

**DIVERSITY & INCLUSION**

**Institutional statement on diversity:** “Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.” [https://diversity.wisc.edu/](https://diversity.wisc.edu/)