Course Description

Pomona Math 103

Combinatorics

What is Combinatorics? Roughly speaking, combinatorics is concerned with the existence, enumeration, analysis, and optimization of discrete structures. It is an exciting, active, and applicable area of mathematics which blends the use of general principles with ad hoc arguments. Unlike many other areas of mathematics—e.g., analysis, algebra, topology—the core of combinatorics is neither its subject matter nor a set of “fundamental” theorems. More than anything else, combinatorics is a collection—some may say a hodgepodge—of techniques, attitudes, and general principles for solving problems about discrete structures. This course will be an introduction to the techniques and methods of combinatorics. In the process of learning how to solve combinatorial problems, the hope is that you will develop an appreciation for the fun, power, and the vast scope of this area of mathematics. Watch [CL: What is Combinatorics?] for a brief intro to the topic.

What topics are covered? The main topics for the course are: (1) Induction and Recurrence Relations, (2) The Pigeonhole Principle and Ramsey Theory, (3) Permutations and Combinations, (4) Binomial coefficients, (5) Stirling Numbers, (6) Integer Partitions, (7) The Inclusion-Exclusion Principle, (8) Generating Functions, (9) Graph Theory, and (10) Partially Ordered Sets.

What are the prerequisites for Math 103? In the Pomona College Math Department, Math 103 is considered a “transition” course between the lower division classes (Calculus & Linear Algebra) and upper division classes. The only prerequisite for the class is Linear Algebra, and, in fact, we will use linear algebra very sporadically. This prerequisite is mostly a “mathematical maturity” prerequisite meant to make sure that you have some experience with mathematics beyond calculus.

Who should take Math 103? Combinatorics is not a prerequisite for any other class. However, it provides excellent preparation for upper division classes in discrete mathematics. These include Computer Science courses, Number Theory, Abstract Algebra, Operations Research, and Probability. Math 103 is really a “problem solving” class, and trains you to be a much better problem solver. In addition, in many areas of mathematics, after peeling off layers of theory, you are confronted with a combinatorial problem. Hence, familiarity and experience with combinatorial problem solving comes in very handy. Combinatorics is especially helpful for students interested in CS.

When should I take 103? While you can take Combinatorics at any time, most students take Math 103 in their first or second year. It is often the first class taken after linear algebra.

Are there overlaps with other classes? Math 103 has a non-trivial intersection with HMC Math 55 (Discrete Math), HMC 104 (Graph Theory), and HMC 106 (Combinatorics). About 1/3 of the material in this class is covered in HMC Math 55 and another 1/3 in HMC Math 104. If you have taken or planning to take HMC Math 106, then you should not take this class. The Combinatorics I class at the Budapest Semesters in Mathematics is also very similar to Math 103. A little bit of combinatorics is done in Probability classes but that overlap is negligible.

Anything unusual about the class? You will be expected to actively engage the material by reading the textbook &/or watch online videos before each class. Much of the class time will be devoted to collaborative work and discussion of the material. The assignments will be spread over the week, and some assignments will be group mini-projects.

What is the workload? When past students were asked “On average, how many hours per week, did you spend on this course outside of class?”, the mean of their answers was 9. Fifty percent of the students reported working between 8 and 12 hours outside of class per week, twenty five percent worked between 5 and 8 hours, and another twenty five percent reported working between 12 and 17 hours a week.