This is a 6 UOC level V course, suitable for students who have taken several years of a variety of University mathematics courses. This includes Honours students, coursework Masters students and undergraduates who have completed 24 units of level III mathematics. Other (motivated and capable) students may enrol with the permission of the Lecturer-in-Charge.

There will be three lectures per week, in weeks 1 - 12. The times for these lectures will be decided at the timetabling meeting at 9:30am on Thursday 25 July 2013 in RC-4082 and will be posted on the MATH5505 Moodle instance. They will also appear on the School’s website, probably on this page:

http://www.maths.unsw.edu.au/currentstudents/timetables

Course aims

Combinatorics is concerned with the existence, enumeration, analysis, and optimization of discrete structures. The course aims to give a general introduction.

Topics will be chosen from introductory combinatorics, including (but not restricted to): Pigeonhole principle and Ramsey theory; Inclusion Exclusion principle and applications; counting sequences and generating functions; partially ordered sets and lattices; Pólya counting; partitions and tableaux.

Relation to other mathematics courses

Combinatorics is a subset of Discrete Mathematics. If you have taken a Discrete Mathematics course then you have already been introduced to combinatorics. Some topics from this course are covered in MATH1081 Discrete Mathematics, but at a much lower level.

In MATH5505 no prior knowledge of combinatorics is assumed, though we do assume familiarity with standard mathematical notation and concepts such as sets, functions. We also assume familiarity with the basic concepts of group theory, and some familiarity with linear algebra and matrices. It may be helpful to be familiar with the structure of finite fields and to remember some basic number theory to do with divisibility. But all necessary definitions will be given when they are needed.
Student learning outcomes

Students taking this course will:

- develop an appreciation of many combinatorial techniques for counting and enumeration,
- develop their ability to select the appropriate technique to solve simple and complex combinatorial problems,
- develop their ability to provide clear and logical proofs.

These outcomes particularly relate to Faculty of Science Graduate Attribute 1: Research, inquiry and analytical thinking abilities and UNSW Graduate Attribute 3: the capacity for analytical and critical thinking and for creative problem solving.

Teaching strategies used

New concepts and techniques are first introduced and demonstrated in lectures, then students master these concepts and techniques by applying them to the problem sets and to assessment tasks. In lectures, students will be expected to think, as well as listen, and will have the opportunity to test their understanding by answering questions posed by the lecturer.

Rationale: We believe that effective learning is best supported when students are actively engaged with the new mathematical concepts and techniques, for example by thinking about the new material, asking questions during lectures and making a serious attempt to solve the problems.

Assessment

The plan is to have 2 assignments worth 20% each, due in weeks 6 and 10, and a final exam worth 60%. This plan will be discussed at the first lecture.

Assessment criteria: In the assignments and the exam, marks will be awarded for correct working, logical setting out, appropriate explanations, clear notation and presentation, as well as for the final answer. The aim of this is to develop students’ ability to present their mathematics in a professional way.

Assessment rationale: Assessment in this course will evaluate the students’ understanding of the combinatorial concepts and methods presented in lectures (Science Graduate Attribute 1) and their mastery of problem-solving techniques developed in lectures, as well as creativity and critical thinking (UNSW Graduate Attribute 3). The assignments will also provide feedback on students’ progress and may introduce new concepts not covered in lectures.

Further assessment information

Assignments may be handwritten or prepared using the mathematical typesetting language \LaTeX. Students may discuss solutions to assignment questions with other students currently taking the course, provided that they write up their solution independently (and not simply copy
from each other) and acknowledge help that they have received from fellow students or from books (giving a reference).

Further information about the exam will be given out in lectures towards the end of the course.

**Additional resources**

**Textbooks:** The content of the course will be defined by the lectures. There is no set text for this course, however there are many reference books.

A course which was somewhat similar to this one was given by Norman Wildberger in 1997. Luckily for us, David Angell was in the audience and took notes. His lecture notes will be made available on Moodle and may be helpful.

Keller and Trotter have made their new book “Applied Combinatorics” freely available online, which may also be helpful:


The library has many books on combinatorics, on level 6 of the main library, all around P511.6, for example:


Problem sets will be handed out in lectures and will be placed on the MATH5505 Moodle site.

Any additional handouts which are produced for this course will also be made available on Moodle.

**Course evaluation and development**

The School of Mathematics and Statistics evaluates each course each time it is run. Feedback on the course is gathered, using among other means, UNSW’s Course and Teaching Evaluation and Improvement (CATEI) Process. Student feedback is taken seriously and continual improvements are made to the course based in part on such feedback.

MATH5505 was last offered in 2007. At the time of writing, the current lecturer has not yet discovered what suggestions the students made in their feedback on this course in 2007, but will make concerted efforts to do so.
Administrative matters

- The School of Mathematics and Statistics has policies regarding attendance, additional assessment, special consideration in the event of illness and misadventure, and so on. *We assume that you are familiar with these policies, so please familiarise yourself with them!* These policies can be found by following links from this page:


  and

  [https://my.unsw.edu.au/student/resources/Policies.html](https://my.unsw.edu.au/student/resources/Policies.html)

- You should also know what plagiarism is and be aware of UNSW’s plagiarism policy. See


  and


- UNSW has advice for students regarding health and safety:


- Information about student equity and diversity (including disabilities):

  [http://www.studentequity.unsw.edu.au](http://www.studentequity.unsw.edu.au)