



COURSE OUTLINE

Never Stand Still

Science

School of Mathematics and Statistics

MATH5505 COMBINATORICS

Semester 1, 2016

MATH5505 – Course Outline

Information about the course

Course Authority and lecturer: Dr. Thomas Britz (RC-5111, britz@unsw.edu.au)

Consultation: Thursday 11–12.

Feel free to drop by my office and/or to email me any other time though too!

Credit, Prerequisites, Exclusions:

This course counts for 6 Units of Credit (6UOC).

The prerequisites for this course are 24 units of level III mathematics or a degree in a numerate discipline or permission of the Head of Department. MATH1081, MATH5425 or equivalent courses are strongly recommended as prerequisites.

Course content:

RAMSEY THEORY: Pigeonhole Principle (R1), Ramsey's Theorem (R2),
Arithmetic Progressions (R3), Equations (R4), Geometry (R5), Applications (R6)

MATCHING THEORY: Hall's Marriage Theorem (M1), König & Dilworth's Theorems
(M2), Applications (M3), Generalisations (M4), Augmenting Paths (M5),
Spanning Trees (M6), Traversing Circuits (M7), Matroids (M8)

INCLUSION-EXCLUSION PRINCIPLE (I1)

POLYA COUNTING (I1 & I2)

EXTREMAL COMBINATORICS: Turan's Theorem (E1), The Four Colour Theorem (E2),
The Erdős-Ko-Rado Theorem (E3), Greene's Theorem (E4)

Class schedule: There will be three class hours per week, with Wednesday classes conducted in Weeks 1–12 and the Thursday class running in Weeks 2–13. These classes will mostly be lectures, with tutorial-style questions interspersed, and with three Reviews that will be more in the style of tutorials than lectures. The class timetable is as follows, where A1 and A2 represent the two Assignments (see below):

Week	Dates	Wed 13–15	Thu 10–11
		CLB 5 (K-E19-G06)	EE G24 (K-G17-G24)
1	March 2, 3	R1	—
2	March 9,10	R2	R3
3	March 16,17	R4	R5
4	March 23,24	R6	Review; A1
Mid-semester break	25 March – 3 April	—	—
5	April 6, 7	M1	M2; A1 due
6	April 13,14	M3	M4
7	April 20,21	M5	M6
8	April 27,28	M7	M8
9	May 4, 5	I1	Review; A2
10	May 11,12	P1	P2
11	May 18,19	E1	E2; A2 due
12	May 25,26	E3	E4
13	June 2	—	Review

Course aims

The aim of MATH5505 is to introduce you to the joys and challenges of core areas of combinatorics. The material will focus on the concepts and ideas and proofs methods, and less on calculations and rote learning. Some of the many proofs and abstract concepts may be subtle or deep but all have been chosen to be elegant and interesting, and hopefully even inspiring. You will be encouraged to think and question independently, to enjoy some research thinking of your own and to contribute your own insights and creations.

Relation to other mathematics and computing courses

This is a 6 UOC (post)graduate level course in combinatorics, suitable if you have already completed a few years of maths courses, particularly MATH1081, MATH5425 Graph Theory or some equivalent course on discrete mathematics.

This course is useful if you are majoring in Pure Mathematics, or plan to teach, or wish to conduct mathematical research. More generally, it showcases beautiful and challengingly fun areas of mathematics that you might not have encountered elsewhere in your studies.

Student learning outcomes

By the end of this course, you will understand and master various parts of combinatorics and the concepts and proofs thereof.

Relation to graduate attributes

These outcomes are related to the development of Science Faculty Graduate Attributes

1. Research, inquiry and analytical thinking abilities;
6. Information literacy.

They are also related to the UNSW Graduate Attribute

3. Capacity for analytical and critical thinking and for creative problem solving.

Teaching strategies underpinning the course

New concepts and proofs are introduced in lectures which will also incorporate tutorial-type questions that will be posed to you in Socratic-style for you to better understand and master the concepts and proofs, and for you to investigate and create your own mathematical questions and contributions.

Rationale for learning and teaching strategies

The School believes that effective learning is best supported by a climate of enquiry, in which you are actively engaged in the learning process. To ensure effective learning, you should participate actively in all classes, whenever possible.

Assessment

The assessment components for this course are

- 2 Assignments worth **20%** each:
Assignment 1 to be given on Thursday 24 March (Week 4)
and due on **Thursday 7 April (Week 5)**, after the 'Break'.
Assignment 2 to be given on Thursday 5 May (Week 9)
and due on **Thursday 19 May (Week 11)**.
- a final **exam** of 3 hours' duration, worth 60%.

Assessment criteria: The main criteria for marking all written assessment tasks will be clear and logical presentation of correct answers.

Assessment in this course will involve demonstrating understanding of the combinatorial concepts presented in lectures (Science Graduate Attribute 1) and will require problem-solving techniques developed in lectures as well as creativity and critical thinking (UNSW Graduate Attribute 3). The Assessment will also provide feedback on your progress.

Assignments

Rationale:

The Assignments will give feedback on your progress and mastery of the material.

Weighting: Each test is worth 20% of your final mark.

The Assignment will consist of a mix of easy and hard questions, to make sure that you are up to speed on coursework and to help you engage in harder proof challenges.

If you are unable to complete an Assignment due to illness, then please contact your lecturer, **not** centrally contact the University. Allowance will be made for this in the final mark by giving greater weighting to the final exam.

Examination

Duration: 3 hours.

Rationale: The final examination will assess your mastery of the material covered in the lectures as well as your ability to visualise and create proofs.

Weighting: 60% of the final mark.

Further details about the final examination will be available in class and on Moodle towards the end of the semester.

Calculators are permitted but will not be of any use.

Additional resources and support

Moodle: Further information and other material will be provided via Moodle; see

<https://moodle.telt.unsw.edu.au/login/index.php>

Check this regularly as more information will be added throughout the session.

Lecture slides: The lecture slides for MATH5505 Combinatorics will be uploaded to Moodle prior, if possible, to lectures, so that you can study the slides before attending the lectures. If time permits, then compact versions of the slides (i.e., lecture notes) will also be provided.

You may also find an abundance of additional material through online searches, and UNSW Library has a nice collection of books that may be of help as well. None of these additional resources are required however: the lectures slides (and notes) will be sufficient.

Administrative matters

Additional assessment

Details on additional assessments are available at

www.maths.unsw.edu.au/currentstudents/assessment-policies

School rules and regulations

Details of the general School rules regarding attendance, release of marks, special consideration and so on are available here:

www.maths.unsw.edu.au/currentstudents/assessment-policies

Plagiarism and academic honesty

Plagiarism is the presentation of another's thoughts or work as one's own. Issues that you must be aware of regarding plagiarism and the university's policies on academic honesty and plagiarism can be found here:

<https://student.unsw.edu.au/plagiarism>