UNSW SYDNEY

School of Mathematics and Statistics

Faculty of Science

MATH5505

Combinatorics

2018 S1

MATH5505 – Course Outline

Information about the course

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

Consultation: Friday 11–12.
Also, please feel free to contact me (Thomas) at other times, by email, Facebook group/Messenger, or just in person. Also, please help each other throughout the course, in class, in person, and through the Facebook group (see below).

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 prerequisites.

Lectures:
There will be three hours of lectures per week, from Weeks 1 to 12.

Wednesday	11:00 - 13:00	Red Centre Theatre (K-H13-G001)
Friday	10:00 - 11:00	Red Centre Theatre (K-H13-G001)

Tutorials:
There will be no tutorials.

Assignments:
There will be 3 challenging and fun Assignments; see below in this document.

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

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

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

Facebook: Feel free to join the course Facebook group here:

MATH5505 Combinatorics 2018S1

This will probably be the easiest way to quickly find, ask, and contribute information, and to discuss in general.

Course aims

Course content:
The aim of MATH5505 is to introduce you to the joys and challenges of core areas of combinatorics, presenting a wide and deep selection of beautiful results and their elegant but sometimes difficult proofs. The material will focus on the concepts and ideas and proofs methods, rather than on calculations or rote learning, and you will be encouraged to think and question deeply and independently, to enjoy some research thinking of your own and to contribute your own insights and creations.
Be aware that there are no tutorials, only lectures and assignments.

The specific course content is as follows.

Ramsey Theory (R)
- The Pigeonhole Principle
- Ramsey's Theorem
- Arithmetic Progressions
- Equations
- Graphs and Geometry
- Applications

Matching Theory (M)
- Hall's Marriage Theorem
- König's Theorem and Dilworth's Theorem
- Applications
- Generalisations
- Augmenting Paths
- Spanning Trees
- Traversing Circuits
- Matroids

Enumerative Combinatorics (E)
- The Inclusion-Exclusion Principle
- Möbius Inversion
- Polya Counting
- Generating Functions

Extremal Set Theory (X)
- Classical Theorem
- Sperner Applications

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 occasionally 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. The course is, however, aimed at training your mathematical maturity, with course notes and lectures to convey the course content to you but with the onus on you to study the material in depth and detail independently on your own, without tutorials to help with this. Instead, three challenging assignments will help you understand the material in depth and also allow you to discover proofs and research thinking for yourself.

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

Assignment 1 (**20%**) given on Fri 9 Mar, **due Friday 23 Mar** (Week 4)
Assignment 2 (**20%**) given on Fri 13 Apr, **due Friday 27 Apr** (Week 7)
Assignment 3 (**20%**) given on Fri 11 May, **due Friday 25 May** (Week 11)

Final Exam (**40%**) of 2 hours' duration.

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 Assignment 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: 2 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: 40% 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.

Lecture and assignment schedule:

Week	Dates	Wed	Fri	Assignment
1	Feb 28, 2	R	R	
2	Mar 7, 9	R	R	A1
3	Mar 14, 16	R	R	
4	Mar 21, 23	M	M	A1 due
5	Mar 28, 30	M	M	
Mid-semester break	30 Mar - 8 Apr	—	—	—
6	Apr 11, 13	M	M	A2
7	Apr 18, 20	M	M	
8	Apr 25, 27	Anzac Day	M	A2 due
9	May 2, 9	E	E	
10	May 9, 11	E	E	A3
11	May 16, 18	X	X	
12	May 23, 25	X	X	A3 due

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 course notes and lecture slides for MATH5505 Combinatorics are found on the course Moodle page.

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 course notes and lectures slides 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`