



UNSW
SYDNEY

Course Outline

MATH1081

Discrete Mathematics

School of Mathematics and Statistics

Faculty of Science

Term 1, 2019

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2. Staff

Position	Name	Email	Room
Course Authority	Assoc. Prof. Jonathan Kress	j.kress@unsw.edu.au	RC-3073
Lecturers	Prof. Catherine Greenhill	c.greenhill@unsw.edu.au	RC-5105
	Dr Thomas Britz	britz@unsw.edu.au	RC-5111
Online Tutorials	Dr Daniel Mansfield	daniel.mansfield@unsw.edu.au	RC-4070

Staff consultation times are provided on Moodle and in the School of Mathematics and Statistics website for current students, undergraduate, student services, help for student's page, at the beginning of each term.

Tutor details for all courses will be provided at the start of term in Moodle.

3. Administrative matters

Contacting the Student Services Office

Please visit the School of Mathematics and Statistics web-site for a wide range of information on School Policies, Forms and Help for Students by visiting the “**Student Services**” page.

For information on Courses, please go to “Current Student”, “Undergraduate and/or Postgraduate” “**Courses Homepage**” for information on all **course offerings**.

The “Student Notice Board” can be located by going to the “Current Students” page; Notices are posted regularly for your information here. Please familiarise yourself with the information found in these locations. The School web page is found: <http://www.maths.unsw.edu.au>

If you cannot find the answer to your queries on the web pages you are welcome to contact the Student Services Office directly. The First Year Advisor in the Student Services Office is Mrs Markie Lugton. All administrative enquiries concerning first year Mathematics courses should be sent to M Lugton, either:

- By email to fy.mathsstats@unsw.edu.au
- By phone: 9385 7011
- Or in person to the Red Centre building, level 3, room 3072

Change of tutorials, due to timetable clashes or work commitments, advice on course selection and other administrative matters are handled in the Student Services Office. Constructive comments on course improvement may also be emailed to the Director of First Year Mathematics, A/Prof Jonathan Kress. Should we need to contact you, we will use your official UNSW email address of zstudentno@student.unsw.edu.au in the first instance. **It is your responsibility to regularly check your university email account. Please state your student number in all emails to the Student Services Office.**

4. Course information

Units of credit: 6

Assumed knowledge): The assumed knowledge for this course is equivalent of a combined mark of at least 100 in the HSC Mathematics and HSC Mathematics Extension 1.

Co-requisite: The formal co-requisite is MATH1131 or MATH1141 or MATH1151. (You must either be taking one of these courses at the same time or have passed one already.)

Teaching times and locations: see the link on the Handbook web page:

Timetable for course MATH1081: <http://timetable.unsw.edu.au/2019/MATH1081.html>

The subject matter of this course is very different from “high school mathematics” and success at high school is no guarantee of success in Discrete Mathematics. In MATH1081 emphasis is placed on reasoned argument and clarity of exposition as well as algebraic and computational skills.

Course summary

MATH1081 will enhance your research, inquiry and analytical thinking abilities as it will provide you with the mathematical language and mathematical techniques to unravel many seemingly unrelated problems. The course will engage you in independent and reflective learning through your independent mastery of a wide range of tutorial problems. The mathematical problem-solving skills that you will develop are generic problem solving skills, based on logical arguments and mathematical language that can be applied in multidisciplinary work. You will be encouraged to develop your communication skills through active participation in tutorials, and by writing clear, logical arguments when solving problems.

Course aims

The aim of MATH1081 is that by the time you finish the course you should understand the concepts and techniques covered by the syllabus and have developed skills in applying these concepts and techniques to the solution of appropriate problems. Successful completion of the course will give you a good foundation for understanding many problems that arise many applications and particularly those in computer science.

Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. State definitions and theorems in the syllabus and apply them to specific examples.
2. Apply the concepts and techniques of the syllabus to solve appropriate problems.
3. Communicate mathematical ideas effectively using correct terminology.
4. Use technology as an aid to communicate mathematical ideas.
5. Recognise and create valid mathematical arguments.

5. Learning and teaching activities

Lecture and Tutorial Schedule

Please note that Lectures commence in week 1 and run to week 10 according to your myUNSW timetable. Lectures may continue into week 11 according to need.

	Monday	Tuesday	Wednesday	Thursday	Friday
Lecture A	10am to 11am Britz 11am to 12pm Greenhill (weeks 1-9,11)		10am to 11am Britz 11am to 12pm Greenhill (weeks 1-5,7-10) 11am to 12pm (week 11 only)		11am to 12pm Greenhill / Britz (weeks 1-8, 10)

Web stream lecture – go to the course Moodle page to locate the recordings	
Tutorials	<p>Note: Students must enrol in pairs of tutorials as follows:</p> <p>Group A (M12): Monday 12pm and Wednesday 9am Group B (M15): Monday 3pm and Wednesday 5pm Group C (T10): Tuesday 10am and Friday 9am Group D (T13): Tuesday 1pm and Thursday 5pm</p>

There are 5 hours of lectures per week except in week 6 when there are 3 hours of lectures. Lectures commence in week 1 and run to week 11. Full details of the timetable are shown in your timetable on myUNSW and the online Handbook.

The material presented is divided into five sections or topics and each part will be presented in 2 or 3 week segments as follows:

Topics	1	2	3	4	5
Lectures	1 to 8	9 to 16	17 to 28	29 to 40	41 to 48

Tutorials

Each student enrolled in MATH1081 has been assigned two tutorial time slots as shown in your timetable. Students can change their tutorials via myUNSW until the end of week 1. After that time, they can only change tutorials by going to the Student Services Office, Red Centre Building room RC-3072 with evidence of a timetable clash or work commitments. NB: Classroom tutorials commence in week 1 and run until week 10.

Each student will have two tutorials per week with the same tutor, with tutorials starting in week 1 and running until week 10. Attendance at tutorials is compulsory and the roll will be called in tutorials.

UNSW Moodle

The School of Mathematics and Statistics uses the Learning Management System called Moodle. To log into Moodle, use your zID and zPass at the following URL: <http://moodle.telt.unsw.edu.au>

Here you will find announcements, general information, notes, lecture slide, classroom tutorial and homework problems and links to online tutorial and assessments

6. Assessment

Assessment overview

The final mark will be made up as follows:

Assessment task	Weight	CLOs
Online Tutorials Weekly: 10% for best 8 of 10; Lab: 15% each for two tests	40%	1,2,5
Assignment	10%	1,2,3,4,5
Final examination	50%	1,2,3,5

Note:

- You will be able to view your final exam timetable once Exams Central has finalised the timetable. Please visit the web page: <https://my.unsw.edu.au/student.unsw.edu.au/exams> for details.
- It is very important that you understand the University's rules for the conduct of Examinations and the penalties for **Academic Misconduct Guide**. This information can be accessed through myUNSW at: <https://student.unsw.edu.au/exams> NB: In recent years, there have been cases where severe penalties have been imposed for misconduct in relation to tests and exams in Maths courses.
- Assessment criteria: UNSW assesses students under a standards based assessment policy. For how this policy is applied within the School of Mathematics and Statistics, please visit the web site: <http://www.maths.unsw.edu.au/currentstudents/assessment-policies>
- If you are unwell / miss your **final examination**, please refer to the Special Consideration Policy available by visiting the website: <https://student.unsw.edu.au/special-consideration>
- Students with a **final mark in the range of 45-49** will be permitted to take the Additional Assessment Exam as a Concessional Additional Assessment (AA). There will be no notification to the individual student of the right to take the Concessional AA, but the details of the courses AA exam schedule will be provided on the School's website Notice Board, after the Provisional Results are published (normally 1 week after the exam period ends).

The final mark after completing the Concessional AA will not increase to a mark higher than 50.

Refer to the School Notice Board website: <http://www.maths.unsw.edu.au/currentstudents/current-students>

Weekly Online Tutorials

Each week there will be online tutorial exercises on Moodle. Instructions will be provided on Moodle. The deadline for each week's exercises will be 5pm on Sunday at the end of weeks 1 to 10. Your best 8 of the 10 weeks will count towards your final mark.

These online exercises will cover basic skills. The material covered in each can include up-coming topics, as preparation to help you get the most out of lectures and tutorials, as well as material already covered in the lectures and tutorials to help you prepare for the class tests.

You are encouraged to work on these exercises in groups other students, but you must only enter answers to your questions that you have worked out for yourself.

The online tutorials come in two versions, practice versions and the main versions which count for marks. Both allow unlimited attempts but only the most recent version of the for-marks Online Tutorial will count.

Lab Tests

As well as completing the weekly online component of the Online Tutorials, you will take two supervised tests based on the same set of questions. These tests will be conducted in a Red-Centre lab in week 5 for the first test and weeks 10 for the second test. You will need to book times for these tests using the link on Moodle.

Assignment

The assignment is designed to help you construct logically correct mathematical arguments and communicate mathematical ideas. Details of the assignment, including assessment criteria will be provided on Moodle. The assignment will be released by Monday of week 5. A draft version of your answers will be due by 5pm on Friday of week 6. You will then review the work of one peer and provide feedback by 5pm on Friday of week 7. Your feedback will be graded by a tutor and this will contribute 5% of your final grade. You must then submit a final version of your assignment by 5pm Friday of week 8. A penalty of 10% (ie one 1% of your final mark) will be deducted for each day late for any of the 3 stages.

Final Examination

The final exam covers material from the whole syllabus. The best guide to the style and level of difficulty is the past exam papers. The course pack contains a book of past exam papers with worked solutions. To see the exact form of the past exam papers, including instructions on the front search for "MATH1081" on the library website. Examination questions are, by their nature, different from short test questions. They may test a greater depth of understanding. The questions will be longer, and sections of the course not covered in other assessments will be examined.

The time and location of the final examination will be available on myUNSW when the final exam timetable is released.

Calculator Information

For end of term UNSW exams, students must supply their own calculator. Only calculators on the UNSW list of approved calculators may be used in the end of term exams. Before the exam period, calculators must be given a "UNSW approved" sticker, obtained from the School of Mathematics and Statistics Office, and other student or Faculty centres. The UNSW list of calculators approved for use in end of term exams is available at: <https://student.unsw.edu.au/exam-approved-calculators-and-computers>

7. Expectations of students

School Policies

The School of Mathematics and Statistics has adopted a number of policies relating to enrolment, attendance, assessment, plagiarism, cheating, special consideration etc. These are in addition to the Policies of The University of New South Wales. Individual courses may also adopt other policies in addition to or replacing some of the School ones. These will be clearly notified in the Course Initial Handout and on the Course Home Pages on the Maths Stats web site.

Students in courses run by the School of Mathematics and Statistics should be aware of the School and Course policies by reading the appropriate pages on the Maths Stats web site starting at:

<http://www.maths.unsw.edu.au/currentstudents/assessment-policies>

The School of Mathematics and Statistics will assume that all its students have read and understood the School policies on the above pages and any individual course policies on the Course Initial Handout and Course Home Page. Lack of knowledge about a policy will not be an excuse for failing to follow the procedure in it.

Academic integrity, referencing and plagiarism

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage.¹ At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity and **plagiarism** can be located at:

- The *Current Students* site <https://student.unsw.edu.au/plagiarism>, and
- The *ELISE* training site <http://subjectguides.library.unsw.edu.au/elise/presenting>

The *Conduct and Integrity Unit* provides further resources to assist you to understand your conduct obligations as a student: <https://student.unsw.edu.au/conduct>.

University Statement on Plagiarism

This statement has been adapted from statements by the St James Ethics Centre, the University of Newcastle, and the University of Melbourne.

Plagiarism is the presentation of the thoughts or work of another as one's own. Examples include:

- Direct duplication of the thoughts or work of another, including by copying work, or knowingly permitting it to be copied. This includes copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement
- Paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- Piecing together sections of the work of others into a new whole;
- Presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and,
- Claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.
- Submitting an assessment item that has already been submitted for academic credit elsewhere may also be considered plagiarism.
- The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does not amount to plagiarism.

Students are reminded of their Rights and Responsibilities in respect of plagiarism, as set out in the University Undergraduate and Postgraduate Handbooks and are encouraged to seek advice from academic staff whenever necessary to ensure they avoid plagiarism in all its forms.

The Learning Centre website is the central University online resource for staff and student information on plagiarism and academic honesty. It can be located at: www.lc.unsw.edu.au/plagiarism

¹ International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- Correct referencing practices;
- Paraphrasing, summarising, essay writing, and time management;
- Appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

8. Readings and resources

Textbook

S.S. Epp, "Discrete Mathematics with Applications", Fourth Edition, 2011 OR Second (or Third) Edition, PWS 1995.

J Franklin and A. Daoud, "Introduction to Proofs in Mathematics", Prentice Hall, 1988 or "Proof in Mathematics: An Introduction", Quakers Hill Press, 1995.

Reference Books

Any book with "Discrete Mathematics" and many with "Finite Mathematics" in their title should help. Previous texts include K.H. Rosen "Discrete Mathematics and its Application" and K. Kalmanson, "An Introduction to Discrete Mathematics and its Applications". A more advanced reference is "Discrete Mathematics" by K. Ross and C.R.B. Wright.

For interesting applications within Computer Science, try the three part classic – D.E.Knuth, "The Art of Computer Programming".

9. Getting help outside tutorials

Staff Consultations

From week 3 there will be a roster which shows for each hour of the week a list of names of members of staff who are available to help students in the first year mathematics courses, no appointment is necessary. This roster is displayed on the same Notice Board as timetables, near the School Office (room 3070, Red Centre), it is also available from the web page: <http://www.maths.unsw.edu.au/currentstudents/consultation-mathematics-staff>

Mathematics Drop-in Centre

The Maths drop-in centre provides free help to students with certain first and second year mathematics courses. First year courses supported are MATH1011, MATH1081, MATH1131, MATH1231, MATH1241 and MATH1251. The Maths Drop-in Centre is in RC-3064, and opening times during term is from 10am – 12pm and 1pm to 3pm from Mondays to Fridays. The Maths drop-in centre schedule will be available on the Schools

website: <https://www.maths.unsw.edu.au/currentstudents/Mathematics-Drop-in-Centre> by the end of week 1. Please note that no appointment is necessary, this is a drop-in arrangement to obtain one-on-one help from tutors.

Additional support for students

- The Current Students Gateway: <https://student.unsw.edu.au/>
- Academic Skills and Support: <https://student.unsw.edu.au/academic-skills>
- Student Wellbeing, Health and Safety: <https://student.unsw.edu.au/wellbeing>
- Disability Support Services: <https://student.unsw.edu.au/disability-services>
- UNSW IT Service Centre: <https://www.it.unsw.edu.au/students/index.html>

10. Special Consideration

Applications for Special Consideration including Additional Assessments

If you feel that your performance in, or attendance at a final examination or another assessment scheduled has been affected by illness or circumstances beyond your control, or if you missed the examination because of illness or other compelling reasons, you may apply for special consideration.

It is essential that you take note of the rules listed below which apply to applications for special consideration in all first year Mathematics courses.

1. Applications must be submitted online within 3 working days of the assessment to which it refers to. In exceptional circumstances, an application may be accepted outside the 3-day limit. Please ensure you contact the Course Authority with advice if your application cannot be submitted within the 3-day limit.

Visit website for further information on how to Apply for Special Consideration, and important things to note: <https://student.unsw.edu.au/special-consideration>

2. Applications for Special Consideration for continuous assessment, such as online tutorials or online exercises that are available for an extended period are only accepted in exceptional circumstances as they already offer substantial flexibility.
3. If your application for Special Consideration is for the final examination, please do not expect an immediate response from the School. All applications will be considered together. See the information below.

Please note that you **will NOT be granted Additional Assessment in a course if your performance in the course** (judged by attendance, class tests, assignments and examinations) **does not meet a minimal standard**. A total mark of greater than 40% on all assessment not affected by a request for Special Consideration will normally be regarded as the minimal standard to allow an Additional Assessment.

4. It is YOUR RESPONSIBILITY to find out from the School of Mathematics and Statistics, whether you have been granted Additional Assessment and when and where the additional assessment examinations will be held. Please visit the School's Notice Board for information: <http://www.maths.unsw.edu.au/currentstudents/current-students>

Information about award of Additional Assessment for the final exam and a provisional list of results will be made available on the Maths & Stats Marks page later in the term. A link to the Maths & Stats Marks page is provided on Moodle.

7. **The Additional Assessment exam for MATH1081 will be held within the period from 22 May to 2 June 2019.** A link to the Additional Assessment timetable, including locations, will be placed on the Current Students Notice Board (see 6 above). You will need to produce your UNSW Student Card to gain entry to the Additional Assessment examination.
8. If you have two Additional Assessment examinations scheduled for the same time, please consult the Student Services Office either by email or phone (fy.mathsstats@unsw.edu.au or 9385 7011), so that special arrangements can be made.

Important Notes

- The Additional Assessment exam may be of a different form to the original exam and must be expected to be at least as difficult.
- If you believe your application for Special Consideration has not been processed, you should immediately consult the Director for First Year Mathematics, Dr Jonathan Kress (Room 3073, Red Centre).
- If you believe that the above arrangements put you at a substantial disadvantage, you should send full documentation of the circumstances to: Director of First Year Mathematics, School of Mathematics and Statistics, email to j.kress@unsw.edu.au at the earliest possible time.
- If you suffer from a chronic or ongoing illness that has, or is likely to, put you at a serious disadvantage, then you should contact the Disability Support Services who provide confidential support and advice. Their web site is: <https://student.unsw.edu.au/disability>

Disability Support Services (DSS) may determine that your condition requires special arrangements for assessment tasks. Once the School has been notified of these, we will make every effort to meet the arrangements specified by DSS.

- Additionally, if you have suffered misadventure during term then you should provide full documentation to the Director of First Year Mathematics as soon as possible. In these circumstances, it may be possible to arrange discontinuation without failure or to make special examination arrangements.

Professor B. Henry
Head, School of Mathematics and Statistics

11. Syllabus

References are to the textbook by Epp, unless marked otherwise. F indicates the textbook by Franklin and Daoud and R indicates the book *Discrete Mathematics with Applications* by K.H. Rosen (6th edition). The UNSW Library has multiple copies of Rosen numbered P510/482A,B,C, etc.

The references shown in the righthand column are *not* intended to be a definition of what you will be expected to know. They are just intended as a guide to finding relevant material. Some parts of the course are not covered in the textbooks and some parts of the textbooks (even in sections mentioned in the references below) are not included in the course.

In the Reference column below, column A refers to Epp 3rd edition, and Rosen 2nd edition, while column B to Epp 4th edition and Rosen 6th edition.

Within sections of the course, the topics may not be covered in exactly the order in which they are listed below.

Topic	References A	References B
1. Sets, functions and sequences		
Sets, subsets, power sets. Equality, cardinality.	5.1, 5.3	1.2, 6.1, 6.3
Set operations: union, intersection, difference, cartesian product.	5.1	6.1
Universal sets, complements.	5.2	6.2
Russell's paradox.	5.4	6.4
Functions. Domain, codomain and range. Arrow diagrams.	7.1, 3.5	1.3, 7.1, 4.5
Ceiling and floor functions. Images and inverse images of sets.		
Injective (one-to-one), surjective (onto) and bijective functions.	7.3	7.2
Composition of functions	7.4	7.3
Inverse functions.	7.2	7.2
Sequences, sums and products. Notation.	4.1	5.1
Change of variable in a sum. Telescoping sums.		
2. Integers, Modular Arithmetic and Relations		
Prime numbers and divisibility	3.1, 3.3	4.1, 4.3
Fundamental Theorem of Arithmetic	3.3	4.3
Euclidean Algorithm	3.8	4.8
Modular Arithmetic	3.4	4.4, 8.4
Solving Linear Congruences	R2.5	R3.7
General Relations	10.1	8.1
Reflexivity, symmetry and transitivity	10.2	8.2
Equivalence Relations	10.3	8.3
Partially ordered sets and Hasse diagrams	10.5	8.5

Topic	References A	References B
3. Logic and Proofs		
Proof versus intuition. Direct proof.	F1	F1
Propositions, connectives, compound propositions.	1.1	2.1
Truth tables. Tautology, contingency, logical equivalence.	1.1	2.1
Implication, converse, inverse, biconditional.	1.2	2.2
Rules of inference.	1.3	2.3
Contrapositive, indirect proof, proof by contradiction.	1.2, 3.6, F6,3.7	2.2,4.6,4.7, F6
Quantifiers	2.1	3.1
Proof of universal statements, exhaustion, proof by cases.	2.1, F2, F3	3.1, F2, F3
Proof of existential statements. Constructive and non-constructive proofs. Counterexamples.	2.1, 3.1, F4, F6	3.1,4.1,F4,F6
Negation of quantified statements.	2.1	3.2
Statements with multiple quantifiers.	2.2, 2.3, F5	3.2,3.3,F5
Common mistakes in reasoning. Converse and inverse fallacies. Begging the question, tacit assumption, etc.	2.3, 3.1	3.3,3.4,4.1
Mathematical induction	4.2-4.4, F8	5.2-5.4,F8
<i>Note:</i> In addition to the sections of Epp mentioned above, sections 4.2–4.5 and 4.7 (3.2–3.5,3.7 for edition 3) provide many useful worked examples of constructing proofs in elementary number theory.		
4. Enumeration and Probability		
Counting and Probability	6.1	9.1
Multiplication Rule	6.2	9.2
Addition Rule	6.3	9.3
Principle of Inclusion-Exclusion	6.3	9.3
Pigeonhole Principle	7.3	9.4
Permutations and Combinations	6.4, 6.5	9.5,9.6
Binomial and Multinomial Theorem	6.7, R4.6	9.7, R5.4
Discrete Probability	R4.4,6.1	R6.1,9.1
Recurrence Relations	8.2, 8.3	5.6,5.7,5.8
Recursively Defined Sets and Functions	8.1	5.9
5. Graphs		
Basic terminology. simple graphs, K_n . Directed graphs. Subgraphs, complementary graphs.	11.1	10.1
Degree, the Handshaking Theorem (Epp Theorem 10.1.1 (11.1.1 in ed. 3))	11.1	10.1
Bipartite graphs, $K_{m,n}$.	11.1	10.1
Adjacency and incidence matrices.	11.3	10.3
Isomorphism, isomorphism invariants.	11.4	10.4
Walks, paths and circuits. Euler and Hamilton paths. Connected graphs, connected components.	11.2	10.2
Planar graphs. Euler's formula. Dual graphs. Necessary conditions for planarity. Kuratowski's Theorem.	R7.7	R9.7
Trees, spanning trees.	11.5, 11.6	10.5,10.7
Weighted graphs. Minimal spanning trees. Kruskal and Dijkstra algorithms.	11.6	10.6,10.7