UNSW SYDNEY

Course Outline

MATH1081

Discrete Mathematics

School of Mathematics and Statistics

Faculty of Science

Semester 1, 2017

Contents

1. Staff

Position	Name	Email	Room
Course Authority	Dr Jonathan Kress	j.kress@unsw.edu.au	RC-3073
Lecturers	Associate Professor Catherine Greenhill Dr Dennis Trenerry	c.greenhill@unsw.edu.au d.trenerry@unsw.edu.au	RC-7105 RC-1039
Lecturer	Dr Denis Potapov Dr David Angell	d.potapov@unsw.edu.au d.angell@unsw.edu.au	RC-6111 RC-3093

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

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

2. 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, permission to take class tests outside your scheduled tutorial, 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, Dr 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.**

3. Course information

Units of credit: 6

Pre-requisite(s): 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.

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

Timetable for course MATH1081:
http://www.handbook.unsw.edu.au/undergraduate/courses/2017/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 in computer science.

Course learning outcomes (CLO)

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

- State definitions as specified in the syllabus.
- State and prove appropriate theorems.
- Explain how a theorem applies to specific examples.
- Apply the concepts and techniques of the syllabus to solve appropriate problems.
- Understand and apply appropriate algorithms.
- Use mathematics and other terminology appropriately to communicate information and understanding.

4. Learning and teaching activities

Lecture and Tutorial Schedule

	Tuesday	Wednesday	Friday
Lecture 1 stream **NB: * asterisk indicates lecture in week 13**	11-1pm***** **Keith Burrows Theatre** Greenhill Weeks 1-4, 12 & **13** Trenerry Weeks 5-11	10-11am **CLB-7** Greenhill Weeks 1-4, 11 &12 Trenerry Weeks 5-10	10-11am **Keith Burrows Theatre** Greenhill Weeks 1-4, 11 & 12 Trenerry Weeks 5-10
Lecture 2 stream **NB: * asterisk indicates lecture in week 13**	11-1pm***** **RC-4082** Potapov Weeks 1-4, 12 & **13** Angell Weeks 5-11	10-11am **CLB-2** Potapov Weeks 1-4, 11 &12 Angell Weeks 5-10	10-11am **RC-M032** Potapov Weeks 1-4, 11 & 12 Angell Weeks 5-10
Note: Students must enroll in pairs of tutorials as follows: Group A: Monday 3-4pm and Wednesday 1-2pm Group B: Tuesday 3-4pm and Friday 11-12pm Group C: Tuesday 3-4pm and Wednesday at 5-6pm Group D: Wednesday 9-10am and Thursday 11-12pm			

Lectures are given four times per week, commencing in week 1 and running to week 12. Full details of the timetable are shown in your timetable on myUNSW and the online Handbook.

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

Section	(1)	(2)	(3)	(4)	(5)
Weeks	1-2	3-4	5-7	8-11 (Tue)*	11 (Wed)-13 (Tue)*

* Note that due to the public holidays on Friday of week 7 and Tuesday of week 8, there will be a 2 hour lecture on Tuesday of week 13.

Tutorials

Each student enrolled in MATH1081 has been assigned two tutorial time slots as shown in your timetable. Students are able to 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 2 and run until week 13.

Each student will have two tutorials per week with the same tutor, with tutorials starting in week 2 and running until week 13. 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

Assessment overview

The final mark will be made up as follows:

Class tests	20%
Final examination	80%

Duration of the final exam is 2 hours.

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 by visiting the website: https://student.unsw.edu.au/special-consideration
- As from S1, 2016 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

Class tests

There will be one test for each of the first four sections outlined in the syllabus above. The best three will count for assessment. Tests will be held in a tutorial in the weeks shown below. Tests for sections (1) and (2) will be held at the beginning of the first tutorial of the week and tests for sections (3) and (4) will be held at the beginning of the second tutorial:

Section	(1)	(2)	(3)	(4)
Week	4	6	9	12

Note:

- You **MUST TAKE EACH TEST IN THE CLASSROOM TUTORIAL TO WHICH YOU HAVE BEEN OFFICIAL ALLOCATED**.
- To each test you **must bring** your **Student ID card**, some blank **A4 writing paper** and a **Stapler** (so that you can staple a cover sheet to your answers).
- Normal exam conditions apply in tests.
- You will **not** be allowed to use a calculator in class tests.
- Your **best three scores** in the four tests will be counted towards your final assessments mark.
- If you miss a **class test** due to illness, please **DO NOT** apply for Special Consideration on-line. You should provide your tutor with a medical certificate in the following week so that your absence can be converted to an M grade to signify a "Medical Absence". The M grade is converted to a mark that is the average result from completed tests, and is recorded towards the end of semester. No more than two "M's" will be accepted in any one semester.
- Tutors are expected to enter class test marks within a fortnight of the test being taken. Your mark will be accessible via the "Maths & Stats Marks" link on the MATH1081 Moodle homepage.
- It is your responsibility to check that these marks are correct and you should keep marked tests until the end of semester in case an error has been made in recording the marks. If there is an error, either speak to your tutor or bring your test paper to the Student Services Office as soon as possible, but no later than Friday in Week 13.

Calculator Information

For end of semester UNSW exams, students must supply their own calculator. Only calculators on the UNSW list of approved calculators may be used in the end of semester 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 semester exams is available at: https://student.unsw.edu.au/exams

5. 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.

6. 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.

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

7. 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”.

8. 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, Math1031, Math1081, Math1131, Math1141 and Math1151. The Maths drop-in centre office is located in RC-3064, and opening times during semester 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

Applications for Special Consideration

If you feel that your performance in, or attendance at a final examination 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. Such an application may lead to the granting of Additional Assessment.

1. Within 3 days of the affected examination, or at least as soon as possible, you must submit a request for Special Consideration to UNSW Student Central **ON-LINE** with supporting documentation attached. Visit website to Apply for Special Consideration:
https://student.unsw.edu.au/special-consideration

2. Please do not expect an immediate response from the School. All applications will be considered together. See the information below.

3. If you miss a **class test** due to illness or other problems, then you should provide the appropriate documentation to your tutor who will record an M. No more than two "M's" will be accepted in any one semester. **DO NOT apply on-line** for Special Consideration for class tests or for on-line or computing tests.

4. If your course involves a MAPLE/MATLAB lab test which you missed, you should contact the lecturer in charge of computing as soon as possible. A resit will be organised for later in the session.

5. **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 for award of Additional Assessment.

6. 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. Do NOT wait to receive official results from the university, as these results are not normally available until after the Mathematics Additional Assessment Exams have started.

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

7. **Additional Assessment exam will be on Monday 17th and Tuesday 18th July, 2017.** A link to the Additional Assessment timetable, including locations, will be placed on the Current Students Notice Board under heading "Special Consideration and Additional Assessment" information.
Web link: http://www.maths.unsw.edu.au/currentstudents/current-students

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.

9. You will need to produce your UNSW Student Card to gain entry to the Additional Assessment examination.

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, University of NSW, Sydney NSW 2052, 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 semester 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

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

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.

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
Note: 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