



# DMTH137

## Discrete Mathematics I

S2 Day 2018

*Dept of Mathematics*

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#### Disclaimer

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

## General Information

Unit convenor and teaching staff

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Credit points

3

Prerequisites

Corequisites

Co-badged status

Unit description

This unit provides a background in the area of discrete mathematics to provide an adequate foundation for further study in computer science. It is also of great interest to students wishing to pursue further study in mathematics. In this unit, students study propositional and predicate logic; methods of proof; fundamental structures in discrete mathematics such as sets, functions, relations and equivalence relations; Boolean algebra and digital logic; elementary number theory; graphs and trees; and elementary counting techniques.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

## Learning Outcomes

On successful completion of this unit, you will be able to:

Knowledge of the principles and concepts of a broad range of areas in mathematical sciences with depth in at least one area

Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences

Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning

Ability to formulate and model practical and abstract problems in mathematical and/or statistical terms using a variety of methods

Application of mathematical and/or statistical principles, concepts, techniques and technology to solve practical and abstract problems.

Appropriate interpretation of information communicated in mathematical and/or statistical form

Appropriate presentation of information, reasoning and conclusions in a variety of modes, to diverse audiences (expert and non-expert).

Ethical application of mathematical and statistical approaches to solving problems

Ability to work effectively, responsibly and safely in an individual or team context.

## General Assessment Information

**HURDLES:** Attendance at, and reasonable engagement in, tutorials in all first year mathematics units is **compulsory**. Participation will be assessed by tutors via rosters and observation of students' work during classes. Attendance and reasonable engagement in the class activities in at least 8 out of 12 of the tutorial classes are requirements to pass the unit.

**IMPORTANT:** If you apply for Special Consideration for your final examination, you must make yourself available for the supplementary exam period. If you are not available in this period, there is no guarantee an additional examination time will be offered. Specific examination dates and times will be determined at a later date.

**ATTENDANCE and PARTICIPATION:** Please contact the unit convenor as soon as possible if you have difficulty attending and participating in any classes. There may be alternatives available to make up the work. If there are circumstances that mean you miss a class, you can apply for Special Consideration.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<u>Assignments</u>	30%	No	See iLearn
<u>Tutorial homework</u>	20%	Yes	Weekly from Week 3
<u>Final Examination</u>	50%	No	University examination period

## Assignments

Due: **See iLearn**

Weighting: **30%**

Three assignments each weighted at 10%.

On successful completion you will be able to:

- Knowledge of the principles and concepts of a broad range of areas in mathematical sciences with depth in at least one area
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning
- Ability to formulate and model practical and abstract problems in mathematical and/or statistical terms using a variety of methods
- Application of mathematical and/or statistical principles, concepts, techniques and technology to solve practical and abstract problems.
- Appropriate interpretation of information communicated in mathematical and/or statistical form
- Appropriate presentation of information, reasoning and conclusions in a variety of modes, to diverse audiences (expert and non-expert).
- Ethical application of mathematical and statistical approaches to solving problems
- Ability to work effectively, responsibly and safely in an individual or team context.

## Tutorial homework

Due: **Weekly from Week 3**

Weighting: **20%**

**This is a hurdle assessment task (see [assessment policy](#) for more information on hurdle assessment tasks)**

Tutorial homework based on the previous tutorial class.

On successful completion you will be able to:

- Knowledge of the principles and concepts of a broad range of areas in mathematical sciences with depth in at least one area
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences
- Ability to construct logical, clearly presented and justified mathematical arguments

incorporating deductive reasoning

- Ability to formulate and model practical and abstract problems in mathematical and/or statistical terms using a variety of methods
- Application of mathematical and/or statistical principles, concepts, techniques and technology to solve practical and abstract problems.
- Appropriate interpretation of information communicated in mathematical and/or statistical form
- Appropriate presentation of information, reasoning and conclusions in a variety of modes, to diverse audiences (expert and non-expert).
- Ethical application of mathematical and statistical approaches to solving problems
- Ability to work effectively, responsibly and safely in an individual or team context.

## Final Examination

Due: **University examination period**

Weighting: **50%**

Two-hour final exam covering any aspect of the unit, but particularly the final topics not yet assessed with an assignment.

On successful completion you will be able to:

- Knowledge of the principles and concepts of a broad range of areas in mathematical sciences with depth in at least one area
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning
- Ability to formulate and model practical and abstract problems in mathematical and/or statistical terms using a variety of methods
- Application of mathematical and/or statistical principles, concepts, techniques and technology to solve practical and abstract problems.
- Appropriate interpretation of information communicated in mathematical and/or statistical form
- Appropriate presentation of information, reasoning and conclusions in a variety of modes, to diverse audiences (expert and non-expert).
- Ethical application of mathematical and statistical approaches to solving problems
- Ability to work effectively, responsibly and safely in an individual or team context.

## Delivery and Resources

### Classes

**Lectures:** you should attend both lectures on each of two days each week, making a total of four hours.

**Tutorials:** you should attend one 1-hour tutorial each week, starting in Week 2.

**Workshops:** the Numeracy Centre runs regular workshops for students in this unit.

### Required and Recommended Texts and/or Materials

The designated text for DMTH137 is

- [Kenneth H Rosen, Discrete Mathematics and its Applications](#), any edition.

#### RECOMMENDED READING

Many of the unit's topics are covered (perhaps going to a deeper level) in other books, such as:

- Grimaldi, *Discrete and Combinatorial Mathematics* (Addison-Wesley-Longman, 2003)
- RL Graham, DE Knuth, O Patashnik, *Concrete mathematics: a foundation for computer science* (Addison-Wesley, 1994)
- WD Hillis, *The pattern on the stone. The simple ideas that make computers work.* (Weidenfeld Nicolson, 1998)
- A Hodges, *Alan Turing: the enigma* (Vintage, 1992)
- DR Hofstadter, *Godel, Escher, Bach: an eternal braid* (The Harvester Press, 1979)
- DE Knuth, *The art of computer programming – Fundamental algorithms* (Addison-Wesley, 1973)
- M Minsky, *Computation: finite and infinite machines* (Prentice-Hall, 1967)
- S Singh, *The Code Book* (Fourth Estate, 1999)
- [CDH Cooper, Mathematics at the Edge of the Rational Universe](#)

These and similar texts are available in the Library.

### Technology Used and Required

Students are expected to have access to an internet-enabled computer with a web browser and Adobe Reader software. Most areas of the university provide wireless access for portable devices. There are computers for student use in the Library.

**Difficulties with your home computer or internet connection do not constitute a reasonable excuse for lateness of, or failure to submit, assessment tasks.**

## Unit Schedule

	30/07/2017	Laws of logic	Propositional logic, truth tables	
	06/08/2017	Predicate logic and negation; Proofs	Sets: operations on sets, Cartesian products, power sets	
	13/08/2017	Relations: symmetry, reflexivity, transitivity, equivalence; Undirected, directed and weighted graphs; degree of a vertex; equivalent graphs	complete graphs; bipartite graphs; walks, paths and cycles; trees and forests	X3
	20/08/2017	Euler's formula; Planar graphs Euler and Hamiltonian cycles	Minimal spanning trees; Kruskal's algorithm; Prim's algorithm with Induction Proofs	X4
	27/08/2017	Functions: injectivity, surjectivity, invertibility	Combinatorics: counting arguments; Permutations and Combinations	A1 X5
	03/09/2017	The Binomial Theorem	Principle of Inclusion-Exclusion	X6
	10/09/2017	Graph coloring; Chromatic polynomial	Graph coloring, continued	X7
	01/10/2017	(No Monday classes)	Vectors, Case study: polygonal shapes	X8
	08/10/2017	Matrices and Linear Transformations	Prime numbers; finding primes, Euclid's algorithm	A2 X9
	15/10/2017	Euclid's algorithm	Extended Euclid's algorithm	X10
	22/10/2017	Binary numbers and arithmetic, arithmetic modulo $n$	congruences, arithmetic modulo $n$	X11
	29/10/2017	Inverses and powers modulo $n$	Revision	A3 X12
	05/11/2017	<b>Revision (Monday)</b> <b>Individual study</b>		X13

## Learning and Teaching Activities

### Lectures

Four 1-hour lectures per week

## Tutorial

One 1-hour tutorial per week, starting in Week 2

## Workshop

Optional workshops provided by Numeracy Centre

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central) (<https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central>). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Grade Appeal Policy](#)
- [Complaint Management Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#) (**Note:** *The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.*)

Undergraduate students seeking more policy resources can visit the [Student Policy Gateway](https://students.mq.edu.au/support/study/student-policy-gateway) (<https://students.mq.edu.au/support/study/student-policy-gateway>). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit [Policy Central](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central) (<https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central>).

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/study/getting-started/student-conduct>

## Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit [ask.mq.edu.au](http://ask.mq.edu.au).

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://stu>



[dents.mq.edu.au/support/](https://dents.mq.edu.au/support/)

## Learning Skills

Learning Skills ([mq.edu.au/learningskills](https://mq.edu.au/learningskills)) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

## Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

## Student Enquiries

For all student enquiries, visit Student Connect at [ask.mq.edu.au](https://ask.mq.edu.au)

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

## Graduate Capabilities

### Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

### Learning outcomes

- Knowledge of the principles and concepts of a broad range of areas in mathematical sciences with depth in at least one area
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning
- Ability to formulate and model practical and abstract problems in mathematical and/or statistical terms using a variety of methods

- Application of mathematical and/or statistical principles, concepts, techniques and technology to solve practical and abstract problems.
- Appropriate interpretation of information communicated in mathematical and/or statistical form
- Appropriate presentation of information, reasoning and conclusions in a variety of modes, to diverse audiences (expert and non-expert).

## **Assessment tasks**

- Assignments
- Final Examination

## **Learning and teaching activities**

- Four 1-hour lectures per week
- One 1-hour tutorial per week, starting in Week 2

## **Capable of Professional and Personal Judgement and Initiative**

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

## **Learning outcomes**

- Knowledge of the principles and concepts of a broad range of areas in mathematical sciences with depth in at least one area
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning
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- Appropriate interpretation of information communicated in mathematical and/or statistical form
- Appropriate presentation of information, reasoning and conclusions in a variety of modes, to diverse audiences (expert and non-expert).

- Ethical application of mathematical and statistical approaches to solving problems
- Ability to work effectively, responsibly and safely in an individual or team context.

## **Learning and teaching activities**

- Four 1-hour lectures per week
- One 1-hour tutorial per week, starting in Week 2

## **Commitment to Continuous Learning**

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

## **Learning outcomes**

- Knowledge of the principles and concepts of a broad range of areas in mathematical sciences with depth in at least one area
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning
- Ability to formulate and model practical and abstract problems in mathematical and/or statistical terms using a variety of methods
- Application of mathematical and/or statistical principles, concepts, techniques and technology to solve practical and abstract problems.

## **Learning and teaching activities**

- One 1-hour tutorial per week, starting in Week 2
- Optional workshops provided by Numeracy Centre

## **Discipline Specific Knowledge and Skills**

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

## Learning outcomes

- Knowledge of the principles and concepts of a broad range of areas in mathematical sciences with depth in at least one area
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning
- Ability to formulate and model practical and abstract problems in mathematical and/or statistical terms using a variety of methods
- Application of mathematical and/or statistical principles, concepts, techniques and technology to solve practical and abstract problems.

## Assessment tasks

- Assignments
- Tutorial homework
- Final Examination

## Learning and teaching activities

- Four 1-hour lectures per week
- One 1-hour tutorial per week, starting in Week 2
- Optional workshops provided by Numeracy Centre

## Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

## Learning outcomes

- Knowledge of the principles and concepts of a broad range of areas in mathematical sciences with depth in at least one area
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning
- Ability to formulate and model practical and abstract problems in mathematical and/or

statistical terms using a variety of methods

- Application of mathematical and/or statistical principles, concepts, techniques and technology to solve practical and abstract problems.

## **Assessment tasks**

- Assignments
- Tutorial homework
- Final Examination

## **Learning and teaching activities**

- Four 1-hour lectures per week
- One 1-hour tutorial per week, starting in Week 2
- Optional workshops provided by Numeracy Centre

## **Problem Solving and Research Capability**

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

## **Learning outcomes**

- Knowledge of the principles and concepts of a broad range of areas in mathematical sciences with depth in at least one area
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning
- Ability to formulate and model practical and abstract problems in mathematical and/or statistical terms using a variety of methods
- Application of mathematical and/or statistical principles, concepts, techniques and technology to solve practical and abstract problems.
- Appropriate interpretation of information communicated in mathematical and/or statistical form
- Appropriate presentation of information, reasoning and conclusions in a variety of modes, to diverse audiences (expert and non-expert).

## Assessment tasks

- Assignments
- Tutorial homework
- Final Examination

## Learning and teaching activities

- Four 1-hour lectures per week
- One 1-hour tutorial per week, starting in Week 2

## Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

## Learning outcomes

- Appropriate interpretation of information communicated in mathematical and/or statistical form
- Appropriate presentation of information, reasoning and conclusions in a variety of modes, to diverse audiences (expert and non-expert).

## Assessment tasks

- Assignments
- Tutorial homework
- Final Examination

## Learning and teaching activities

- Four 1-hour lectures per week
- One 1-hour tutorial per week, starting in Week 2

## Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

### **Learning outcome**

- Ethical application of mathematical and statistical approaches to solving problems

## **Socially and Environmentally Active and Responsible**

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

### **Learning outcomes**

- Ethical application of mathematical and statistical approaches to solving problems
- Ability to work effectively, responsibly and safely in an individual or team context.

## **Changes from Previous Offering**

Small changes in ordering of topics. Tutorial homework designated a hurdle requirement.