



UNSW Course Outline

MATH1141 Higher Mathematics 1A - 2024

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General Course Information

Course Code : MATH1141

Year : 2024

Term : Term 1

Teaching Period : T1

Is a multi-term course? : No

Faculty : Faculty of Science

Academic Unit : School of Mathematics & Statistics

Delivery Mode : Multimodal

Delivery Format : Standard

Delivery Location : Kensington

Campus : Sydney

Study Level : Undergraduate

Units of Credit : 6

Useful Links

[Handbook Class Timetable](#)

Course Details & Outcomes

Course Description

This course builds on high school calculus-based courses to provide a solid foundation for further study in mathematics for students in STEM disciplines. It is taken by undergraduate students typically in their first year and is usually followed by MATH1241 or MATH1231 and, as

the higher version of MATH1131, has greater depth and a greater emphasis on proof and rigorous argument than MATH1131. The Calculus half of the course develops a deeper understanding of continuous and differentiable functions and introduces the Riemann integral. It shows how theorems such as the Maximum-Minimum Theorem, the Intermediate Value Theorem and Mean Value Theorems are used to rigorously justify properties of common functions and to solve both theoretical and applied problems. The Algebra half of the course introduces vectors and matrices and the solution of systems of linear equations by Gaussian elimination which paves the way for linear algebra in later courses. Technology is used throughout the course through use of the Maple computer algebra system and students producing a typeset assignment. Students are assumed to have a good understanding of NSW HSC Mathematics Extension 1 and 2 subjects.

Course Aims

The aim of this course is to provide a foundation for further study in mathematics. The course introduces the theorems and definitions on which Calculus is built and vectors, matrices and Gaussian elimination which will form the basis for the study of Linear Algebra. The course also builds mathematical communication skills and introduces students to computer algebra systems.

Relationship to Other Courses

Exclusions: MATH1011, MATH1031, MATH1131, MATH1151, ECON1202

Related course: MATH1141 is a higher version of MATH1131

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Apply definitions and theorems in Algebra and Calculus to justify mathematical statements and solve problems.
CLO2 : Apply concepts and techniques from Algebra and Calculus to solve problems.
CLO3 : Use technology as an aid to solve appropriate problems in Algebra and Calculus.
CLO4 : Communicate mathematical ideas in written and oral form using correct terminology and using technology.
CLO5 : Apply concepts in Algebra and Calculus to unexpected contexts.
CLO6 : Identify and construct valid mathematical arguments and proofs of theorems.

Course Learning Outcomes	Assessment Item
CLO1 : Apply definitions and theorems in Algebra and Calculus to justify mathematical statements and solve problems.	<ul style="list-style-type: none">• Weekly Lessons• Assignment• Final Examination
CLO2 : Apply concepts and techniques from Algebra and Calculus to solve problems.	<ul style="list-style-type: none">• Lab Tests• Weekly Lessons• Assignment• Final Examination
CLO3 : Use technology as an aid to solve appropriate problems in Algebra and Calculus.	<ul style="list-style-type: none">• Lab Tests• Weekly Lessons• Final Examination
CLO4 : Communicate mathematical ideas in written and oral form using correct terminology and using technology.	<ul style="list-style-type: none">• Assignment• Weekly Lessons• Final Examination
CLO5 : Apply concepts in Algebra and Calculus to unexpected contexts.	<ul style="list-style-type: none">• Assignment• Weekly Lessons• Final Examination
CLO6 : Identify and construct valid mathematical arguments and proofs of theorems.	<ul style="list-style-type: none">• Assignment• Weekly Lessons• Final Examination

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360 | Möbius Platform, Maple Application

Learning and Teaching in this course

Lectures

The lectures start in Week 1 and continue until Week 10 with a break in Week 6. They will be in-

person and these will be streamed live online via Echo360. A link will be provided on Moodle. These lectures will also be recorded and available to watch at a later time, however, it is recommended that students attend the lectures live, whether in-person or online.

Classroom Tutorials

Classroom Tutorials start in Week 1 and continue until Week 10 with a break in Week 6. They will be in-person and face-to-face. The time and location for your Classroom Tutorial can be found on myUNSW. You can change your tutorial via myUNSW until the end of Week 1. After that time, you can only change tutorials by contacting the Mathematics and Statistics Student Services with evidence of a timetable clash or work commitments.

The Classroom Tutorial will be a mix of Algebra and Calculus each week. Participation in a minimum number of these tutorials is required and contributes 5% of your final mark. At the start of each tutorial you will be given a set of problems that you will work on in small groups. While you will not have these problems in advance, you should prepare by working on the suggested homework problems, indicated on Moodle.

The Classroom Tutorials are designed to help you understand important concepts, develop skills in tackling new unseen problems and improve your written and oral mathematical communication skills.

If your tutorial falls on a public holiday, it will be cancelled for that week. You can optionally attend another tutorial class that week or work on the material in your own time.

Problem/Q&A sessions

These are tutor-led problem based classes that will cover a mix of homework and other problems each week from Week 1 to 10 with a break in Week 6. They are also a place where you can ask anything. While in the Classroom Tutorials, you will work together with other students in groups guided by a tutor, in these sessions, the tutor will discuss the solution to problems with the whole class. These can be attended in-person or online and will be recorded. Attending live and in-person is recommended as you will be able to ask questions during the class. The time and location of this class is shown in your timetable on myUNSW as second class in the week for TUT.

Weekly Möbius Lessons

The Weekly Lessons are an integral part of this course; they help you to stay up-to-date with the course content and give an alternative view on the course materials.

Moodle

Log into Moodle to find announcements, general information, notes, lecture slides, classroom tutorial and homework problems, and links to Weekly Lessons and assessments.

<https://moodle.telt.unsw.edu.au/>

Möbius

All assessments in this course, including Weekly Lessons, use a system called Möbius. Information on how to access and use Möbius is provided on Moodle.

Maple and Computing

The aim of the computing component is twofold:

1. You will use the symbolic computing package Maple to conduct mathematics on the computer. This usage of Maple is integrated with the algebra and calculus streams and the assessments of this course, and is designed to enhance your understanding of the mathematics involved, as well as letting you use software as a tool to do mathematics. You will find the skills you acquire and things you learn useful in many other subjects of study, both within and outside the School of Mathematics and Statistics. Maple enables you to tackle larger, harder and more real-world mathematical problems, since it can handle all the difficult algebra and calculus for you. Furthermore, learning some Maple introduces you to some of the basic ideas of computer programming.
2. You will gain some experience in teaching yourself how to use a complicated computing package. Independently learning to use technical software is a valuable skill required in other courses at UNSW and in the workforce.

Maple is available for Windows, Mac and Linux, but is not freeware. UNSW provides a free cloud-based virtual version of Maple that students in first-year mathematics courses can access on their personal devices. For details, please see the myAccess website:

<https://www.myaccess.unsw.edu.au/>

The learning aspect of the computing component of MATH1231 follows on from the computing component of MATH1131/1141. The introductory materials from MATH1131/1141 will be provided on Moodle for revision if you need them.

From Week 1 onwards, you are expected to independently master Chapter 1 and all the remaining sections of Chapter 2 in the First Year Maple Notes by completing the self-contained Self-Paced Maple Lessons (and by seeking and obtaining help from the Lab Consultants as necessary; see below). You are expected to work steadily through these modules as part of the Weekly Lessons. The online teaching package consists of the following modules:

- **Module 0. Getting Started**
- **Module 1. The Basics**
- **Module 2. Functions**
- **Module 3. Basic Calculus**
- **Module 4. Collections of Expressions**
- **Module 5. Complex Numbers and Equations**
- **Module 6. Plotting**
- **Module 7 Linear Algebra**

During the term, the assessment for the computing component of the course is embedded in the Weekly Lessons (including the Lab Tests), and is linked to topics in algebra and calculus, so knowledge of other parts of the course is required. The Final Examination may contain some questions requiring knowledge of Maple.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Weekly Lessons Assessment Format: Individual	15%	Start Date: Weekly Möbius Lessons become available two weeks before due date. Due Date: Weekly Möbius Lessons are due on Tuesday at 11:00 AM
Lab Tests Assessment Format: Individual	25%	Start Date: Practice tests for Lab Tests 1 and 2 released at least one week before each test. Due Date: See the EXM class in your myUNSW timetable for your Lab Test time and location.
Assignment Assessment Format: Individual	10%	Start Date: Early Week 5 Due Date: Week 8 Tuesday 11:59 PM
Final Examination Assessment Format: Individual	50%	Start Date: During the exam period Due Date: See Moodle for details of your exam date and time.

Assessment Details

Weekly Lessons

Assessment Overview

The Weekly Lessons cover all aspects of the course, including Algebra, Calculus and the use of the Maple computer algebra system. They will consist of both online self-paced lessons with weekly due dates and in-class activities during the weekly tutorial class. For each topic in the online component, you will watch a short video or complete a self-paced lesson and work through some accompanying exercises on Mobius. You will be provided with instant feedback and unlimited repeat attempts. The in-class component will complement the self-paced online lessons. You will engage in activities more suited to discussion and oral communication of mathematical ideas, such as constructing proofs and improving your mathematical communication.

Course Learning Outcomes

- CLO1 : Apply definitions and theorems in Algebra and Calculus to justify mathematical statements and solve problems.
- CLO2 : Apply concepts and techniques from Algebra and Calculus to solve problems.
- CLO3 : Use technology as an aid to solve appropriate problems in Algebra and Calculus.
- CLO4 : Communicate mathematical ideas in written and oral form using correct terminology and using technology.
- CLO5 : Apply concepts in Algebra and Calculus to unexpected contexts.
- CLO6 : Identify and construct valid mathematical arguments and proofs of theorems.

Detailed Assessment Description

The Mobius component of the Weekly Lessons contributes 10% of the 15% to the Weekly Lessons mark and the Classroom Tutorials component contributes 5%. Only your best 6 of 9 weeks of the Weekly Mobius Lessons are counted towards this mark. Each Classroom Tutorial, in which the tutor awards you a mark, contributes 1% up to a maximum of 5%.

Note:

- Your work on Weekly Lessons must be your own, but you are encouraged to discuss the methods required in collaboration with other students.
- Each version of a Weekly Lesson will be slightly different.
- You are expected to complete all 9 Weekly Lessons, but only your best grade from 6 of the 9 weeks will be counted towards the final grade.
- You can ask for help with these exercises and you can check your answers as you go, so most students obtain a perfect score and you should aim for this.
- **No deadline extensions will be granted** unless you have documented reasons beyond your control covering at least 4 weeks. You should attempt these tests with sufficient remaining

time to allow for unplanned service interruptions.

Assessment Length

One week

Submission notes

Möbius Platform and Classroom Participation

Assessment information

Since only the best 6 out of 9 Weekly Lessons count for marks, special consideration for Weekly Lessons will only be considered for students who have appropriate documentation to explain missing **more than 3** Weekly Lessons. Special consideration will generally not be awarded for the classroom tutorials because only 5 of the 9 weeks are needed to obtain the full 5%.

Assignment submission Turnitin type

This is not a Turnitin assignment

Lab Tests

Assessment Overview

You will complete two Lab Tests during the term. These tests are focused on basic skills in both Algebra and Calculus and will be a mix of questions that can be solved by hand and with the Maple computer algebra system. Before each test you will be provided with the actual test question bank. This test bank provides unlimited practice attempts with instant feedback. You will be able to practice until you can solve all the problems quickly and accurately. The tests have a 40-minute duration and will be supervised in a computer lab on campus. Lab Tests 1 and 2 will contribute 10% and 15% respectively of the overall course grade.

Course Learning Outcomes

- CLO2 : Apply concepts and techniques from Algebra and Calculus to solve problems.
- CLO3 : Use technology as an aid to solve appropriate problems in Algebra and Calculus.

Detailed Assessment Description

These tests will be conducted in-person at the times and locations listed as the EXM classes on your Class Timetable on myUNSW (you may need to select the specific weeks to view these). Any variations to these will be announced on Moodle or via email. **You will have a single attempt at each Lab Test.**

For Lab Test 1, you will not be able to use software such as Maple. For Lab Test 2, you will be required to use Maple for some questions. In Lab Test 2 some questions will be based on the

Maple coding topics of the Weekly Lessons (covered in Chapters 1 and 2 of the First Year Maple Notes) in addition to Algebra and Calculus questions that can be solved by hand.

During these tests you will be provided with the following resources on the lab computer.

- Algebra Notes from the coursepack;
- Calculus Notes from the coursepack;
- Maple Notes from the coursepack;
- Maple self-paced lesson.

You must bring the following to your test.

- The device you use for MFA so that you can log in to Möbius;
- Your UNSW Student ID card;
- Any pens, pencils, erasers, rulers and other static drawing aids that you wish to use.

No other devices or resources are permitted in either Lab Test 1 or 2. For example, you CANNOT bring the following.

- A handheld calculator.
- Notes other than those provided on the computer.
- Paper for working. (Rough working paper will be provided.)

The entire question bank of possible test problems will be provided in your MATH1141 Möbius class. There, you will also find a Practice Lab Test with the same format as the actual Lab Test. You are allowed an unlimited number of attempts at the practice tests, and these do not count for marks.

You are expected to have worked out exactly how to answer the questions before you attend the real in-person tests because you are granted unlimited practice at the question bank, and you can review your results for these tests in the Möbius gradebook.

Assessment Length

40 minutes

Submission notes

Möbius Platform

Assignment submission Turnitin type

This is not a Turnitin assignment

Assignment

Assessment Overview

The purpose of the assignment is to improve your written mathematical communication. You will be presented with individualised questions and you will produce typed solutions using Microsoft Word, LaTeX or another similar system. You will be able to check the correctness of some parts of your answers prior to submission so your main task will be to create a well-presented written document containing your solutions. The assignment will be released in Week 5 and will be due in Week 8. You will be provided with feedback on the clarity of your communication of mathematical ideas and the correctness of your solutions approximately two weeks after submission.

Course Learning Outcomes

- CLO1 : Apply definitions and theorems in Algebra and Calculus to justify mathematical statements and solve problems.
- CLO2 : Apply concepts and techniques from Algebra and Calculus to solve problems.
- CLO4 : Communicate mathematical ideas in written and oral form using correct terminology and using technology.
- CLO5 : Apply concepts in Algebra and Calculus to unexpected contexts.
- CLO6 : Identify and construct valid mathematical arguments and proofs of theorems.

Detailed Assessment Description

The Assignment is designed to provide feedback on your writing and help you recognise good mathematical writing for future study. It will also give you practice at presenting written solutions to exam-style questions.

The questions will be presented to you on Möbius, and you will write solutions to these questions in a typed document. You will be able to check the mathematical correctness of some parts of your answer using Möbius, so your main task will be to present your answers well with good explanations of your working. Your marker will grade your work based on the following aspects; note that the marking criteria are focused on how you explain and present your answers:

1. Is the work written in sentences and paragraphs with correct grammar?
2. Is the level of written explanation sufficient for someone who did not know how to solve this problem to follow the argument? Are the explanations concise and clear? Do the explanations avoid unnecessary detail or irrelevant information?
3. Are the arguments self-contained and can be understood without reference to the question?
Are the conclusions written out clearly?
4. Are the mathematical arguments valid?
5. Are the equations typeset using an equation editor or similar? Are mathematical symbols

within the text typeset as mathematical symbols? Are equations and mathematical expressions formatted appropriately?

You will submit your work online via a Turnitin link on Moodle. The assessment deadline will be 11:59 pm on Tuesday of Week 8. The assignment will have a maximum mark of 10. A penalty of 5% of the maximum mark will be deducted from the awarded mark per day late up to a maximum of 5 days late. **Submissions over 5 days late will receive a mark of zero.**

Complete details of the process for this will be provided when the assignment is released.

Assessment Length

Complete solutions to all questions

Submission notes

Must be typed using software with an equation editor (e.g. Word, LaTeX).

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Final Examination

Assessment Overview

The final examination covers all aspects of the course. The assessment tasks during the term allow repeated attempts over an extended period and focus more on basic skills. The exam focuses on questions that assess deeper understanding and higher-level skills, such as applying a theorem or technique in an unexpected context or to a new application, combining ideas from different topics and constructing rigorous mathematical arguments within the context of the syllabus.

The examination will be supervised during the official examination period.

Course Learning Outcomes

- CLO1 : Apply definitions and theorems in Algebra and Calculus to justify mathematical statements and solve problems.
- CLO2 : Apply concepts and techniques from Algebra and Calculus to solve problems.
- CLO3 : Use technology as an aid to solve appropriate problems in Algebra and Calculus.
- CLO4 : Communicate mathematical ideas in written and oral form using correct terminology and using technology.
- CLO5 : Apply concepts in Algebra and Calculus to unexpected contexts.

- CLO6 : Identify and construct valid mathematical arguments and proofs of theorems.

Detailed Assessment Description

The Final Examination will be conducted using Möbius. The exam will be conducted in-person in the Anita B. Lawrence Centre Computing Labs. The approximate date and time will be available on myUNSW. Your actual precise date, time and location will be provided on Moodle. Further details of the exam arrangements will be available on Moodle after the final exam timetable is released.

The best guide to the style and level of difficulty of the Final Examination is the past exam papers. These will be provided on Moodle. Some have worked solutions and others do not. Examination questions are, by their nature, different from the Lab Test questions; the questions may be longer, test a greater depth of understanding, and test sections of the course not covered in other assessments. Some parts of the Final Examination may require knowledge of Maple.

This term's Final Examination will be closest in format to the exams from 2020 onward. More specific information on the format will be provided on Moodle closer to the end of Term.

Assessment Length

2 hours

Submission notes

Möbius Platform

Assessment information

The assessment tasks during the term allow repeated attempts over an extended period and focus more on basic skills. As a result, you should be aiming for a high mark in the pre-exam assessment material, and this indicates significant progress towards achieving the CLOs of MATH1141. The Final Examination is time-limited and has more complex questions. Therefore, a high mark in the pre-exam assessment is not always an accurate indication of the final course mark.

You are expected to be available for both the main exam period and, in case you cannot attend the exam due to illness or other misadventure, the supplementary exam period. The supplementary exam period dates can be found via the [UNSW Key Dates page](#).

Assignment submission Turnitin type

This is not a Turnitin assignment

General Assessment Information

The assessment structure of MATH1141 may be quite different to high school and other courses that you are used to. It is designed so that you should expect to be close to passing the course before taking the Final Examination, with pre-exam assessments (Weekly Lessons, Lab Tests, Assignment) focusing on basic skills, and the Final Examination itself focusing on more advanced skills.

- The Möbius component of the Weekly Lessons allow you to check your answers, they are available for an extended period, you can collaborate with peers, seek help and use any resources you wish, as long as the answers you enter are your own. Most students gain a perfect score for these lessons. Some of these lessons may be designed to be preparation for the following week's lectures and introduce material not yet seen in the lectures.
- Classroom Tutorials component of the Weekly Lessons cover both basic and advanced skills. However, the mark associated with these is for your engagement with the material and oral communication of mathematics, and so does not require mastery of advanced skills.
- The Lab Tests allow you unlimited practice of questions from the question bank used in these tests. For this reason, you should aim for a mark of 80% or higher in the Lab Tests. Marks below this threshold should be seen as a warning sign of possible failure in the course.
- The Assignment is available over an extended period and students can work on this with the benefit of all the course resources. Students who pass MATH1141 typically obtain a mark of at least 6 or 7 out of 10 for the Assignment.
- The average mark for pre-exam work is typically well over 40/50.

Notes:

- You will be able to view your final exam timetable on myUNSW. Note that the exam may run over multiple sessions, possibly covering several days, but this will not appear on myUNSW, so you must also check Moodle for details of your exam time. Details of when this timetable will be released is available on the university website: <https://student.unsw.edu.au/dates-and-timetables>.
- It is crucial that you understand UNSW's rules for the conduct of assessments and the penalties for academic misconduct. This information can be accessed through myUNSW at <https://student.unsw.edu.au/conduct>.
- In recent years, there have been cases where severe penalties have been imposed for misconduct in relation to tests and exams in mathematics courses.
- UNSW assesses students under a standards-based assessment policy. For more information on how this policy is applied within the School of Mathematics and Statistics, please refer to the following website:
[https://www.unsw.edu.au/science/our-schools/mathematics/student-life-resources/
student-services/assessment-policies](https://www.unsw.edu.au/science/our-schools/mathematics/student-life-resources/student-services/assessment-policies).
- For more information on how UNSW implements special consideration policies for assessments during the term and the Final Examination, please refer to the following website:
<https://student.unsw.edu.au/special-consideration>.

Grading Basis

Standard

Requirements to pass course

To pass MATH1141, you need a final mark of 50/100 or greater overall. There is no requirement to gain any particular mark in any individual assessment items.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 12 February - 18 February	Online Activity	Weekly Möbius Lessons commence in Week 1 and continue until Week 10 with a break in Week 6. Each week's Lessons are due on the following Tuesday. The Weekly Möbius Lessons contribute 10% of your overall course mark.
	Lecture	Lectures commence in Week 1 and continue until Week 10 with a break in Week 6.
	Tutorial	Tutorials commence in Week 1 and continue until Week 10 with a break in Week 6. Note that participation in Tutorials contributes 5% of your overall course mark. Your Tutorial is shown in your timetable on myUNSW as the TUT class on Monday, Tuesday or Wednesday.
	Tutorial	The Problem/Q&A session starts in Week 1. This is shown in your timetable on myUNSW as the TUT class on Thursday or Friday. These sessions continue each week until Week 10 with a break in Week 6. This is a tutor-led session in which tutor will discuss homework and other problems and answer your questions about any aspect of the course.
Week 2 : 19 February - 25 February	Other	Lectures, Classroom Tutorials and the Q&A Problem sessions continue.
	Online Activity	The Week 1 Weekly Möbius Lesson is due on Tuesday at 11am. Deadlines for future weeks are always at 5pm on the following Tuesday. They are not shown in the schedule below.
Week 3 : 26 February - 3 March	Other	Weekly Möbius Lessons, Lectures, Classroom Tutorials and the Q&A Problem sessions continue.
	Homework	Prepare for Lab Test 1 which is next week.
Week 4 : 4 March - 10 March	Other	Weekly Möbius Lessons, Lectures, Classroom Tutorials and the Q&A Problem sessions continue.
	Assessment	Lab Test 1 (see EXM class in your myUNSW Timetable for the time and location.)
Week 5 : 11 March - 17 March	Other	Weekly Möbius Lessons, Lectures, Classroom Tutorials and the Q&A Problem sessions continue.
	Assessment	Assignment questions released on Möbius.
Week 6 : 18 March - 24 March	Other	Flexibility Week. There are no classes or assessment deadlines this week. The Week 5 Möbius Lesson deadline is on Tuesday of Week 7.
Week 7 : 25 March - 31 March	Other	Weekly Möbius Lessons, Lectures, Classroom Tutorials and the Q&A Problem sessions continue.
Week 8 : 1 April - 7 April	Other	Weekly Möbius Lessons, Lectures, Classroom Tutorials and the Q&A Problem sessions continue.
	Assessment	Assignment due at 11:59pm Tuesday Week 8.
Week 9 : 8 April - 14 April	Other	Weekly Möbius Lessons, Lectures, Classroom Tutorials and the Q&A Problem sessions continue.
	Homework	Prepare for Lab Test 2 which is next week.
	Other	For Term 3, the exam time and location will be announced this week at the latest. For Term 1, the exam session booking page released on Moodle at 8am on Wednesday. Book early if you wish to secure a convenient time.
Week 10 : 15 April - 21 April	Other	Weekly Möbius Lessons, Lectures, Classroom Tutorials and the Q&A Problem sessions continue.
	Assessment	Lab Test 2 (see EXM class in your myUNSW Timetable for date and time.)
	Other	For Term 1, the exam session booking page closes at 8am on Wednesday. Students who have not booked will be assigned a time.

Attendance Requirements

Engagement with Classroom Tutorials activities contributes 5% of your final grade.

General Schedule Information

Note that all lectures and some tutorials will be recorded, and this may include student comments. Recorded lectures and tutorials will be indicated on Moodle.

Lectures and tutorials run in all Weeks from 1 to 10, except for Week 6 which will have no classes.

Algebra Stream - Syllabus and Lecture Timetable

The algebra stream for MATH1141 is based on Chapters 1 to 5 of the MATH1131/1141 Algebra Notes in the Course Pack:

- Chapter 1: Introduction to Vectors
- Chapter 2. Vector geometry
- Chapter 3: Complex Numbers
- Chapter 4: Linear Equations and Matrices
- Chapter 5: Matrices

Lecturers will not cover all the material in these notes in their lectures, as some sections of the notes are intended for reference and for background reading.

The following is a basic timetable and syllabus which will be followed by MATH1141 algebra lecturers. Lecturers may try to follow this timetable (assuming 22 hours algebra lectures), but some variations are inevitable.

1. Vector quantities and \mathbb{R}^n (1.1, 1.2)
2. \mathbb{R}^2 and analytic geometry (1.3)
3. Points, line segments and lines. Parametric vector equations. Parallel lines. (1.4)
4. Planes. Linear combinations and the span of two vectors. Planes through the origin. Parametric vector equations for planes in \mathbb{R}^3 . The linear equation form of a plane. (1.5)
5. Lengths, angles and the dot product in \mathbb{R}^2 , \mathbb{R}^3 , \mathbb{R}^n . (2.1, 2.2)
6. Orthogonality and orthonormal basis, projection of one vector on another. Orthonormal basis vectors. Distance of a point to a line. (2.3)
7. Cross product: definition and arithmetic properties, geometric interpretation of cross product as perpendicular vector and area. (2.4)
8. Scalar triple products, determinants and volumes. Equations of planes in \mathbb{R}^3 the parametric

- vector form, linear equation (Cartesian) form and point-normal form of equations, the geometric interpretations of the forms and conversions from one form to another. Distance of a point to a plane in \mathbb{R}^3 . (2.5, 2.6)
- 9. Development of number systems and closure. Definition of complex numbers and of complex number addition, subtraction and multiplication. (3.1, 3.2, start 3.3)
 - 10. Division, equality, real and imaginary parts, complex conjugates. Argand diagram, polar form, modulus, argument. (Finish 3.3, 3.4, 3.5, 3.6)
 - 11. De Moivre's Theorem and Euler's Formula. Arithmetic of polar forms. (3.7, 3.7.1)
 - 12. Powers and roots of complex numbers. Binomial theorem and Pascal's triangle. (3.72, 3.73, start 3.8)
 - 13. Complex polynomials. Fundamental theorem of algebra, factorization theorem, factorization of complex polynomials of the form $z - z_0$, real linear and quadratic factors of real polynomials. (3.10)
 - 14. Introduction to systems of linear equations. Solution of 2×2 and 3×3 systems and geometrical interpretations. (4.1)
 - 15. Matrix notation. Elementary row operations (4.2, 4.3)
 - 16. Solving systems of equations by Gaussian elimination (4.4)
 - 17. Deducing solubility from row-echelon form. Solving systems with indeterminate right hand side. (4.5, 4.6)
 - 18. General properties of solutions of $Ax = b$ (4.7, 4.8)
 - 19. Operations on matrices. Transposes. (5.1, 5.2)
 - 20. Inverses and definition of determinants. (5.3, 5.4)
 - 21. Properties of determinants. (5.4)
 - 22. Review

Calculus Stream - Syllabus and Lecture Timetable

The calculus stream for MATH1141 is based on Chapters 1 to 5 of the MATH1131/1141 Calculus Notes in the Course Pack. Lecturers will not cover all the material in the Course Pack notes in their lectures, as some sections of the notes are intended for reference and for background reading.

The Calculus textbook is S.L. Salas & E. Hille and G.J. Etgen Calculus - One and Several Variables, any recent edition, Wiley. References to the 10 th edition are shown as SH10. To improve your understanding of definitions, theorems and proofs, the following book is recommended: Introduction to Proofs in Mathematics, J. Franklin & A. Daoud, Prentice-Hall.

In addition, for MATH1141, for help with understanding the foundations of calculus you will find the following book readable and useful: Calculus by M. Spivak (there are multiple copies in the library). References to Spivak are shown as SP.

In this syllabus, the references to the textbook are not intended as a definition of what you will be expected to know. They are just a guide to finding relevant material. Some parts of the course are not covered in the textbook and some parts of the textbook (even in the sections mentioned in the references below) are not included in the course. The scope of the course is defined by the content of the lectures and problem sheets. The approximate lecture time for each section is given below.

- **Chapter 1: Sets, inequalities and functions (2 hours)**
 - □ □ □ Open and closed intervals. Inequalities. (SH10 1.2, 1.3) (SP 1, 2)
 - Functions: sums, products, quotients, composites. Polynomials, rational functions, trig functions as examples of continuous functions. Implicitly defined functions. 1.6-1.7 3, 4
- **Chapter 2: Limits (2 hours)**
 - MATH1131: Informal definition of limit at a point ($x \rightarrow a$; a finite) MATH1141: Formal definition of limit at a point ($x \rightarrow a$; a finite) (SH10 2.1, 2.2 pp177-178 & 195-198) (SP 5)
 - Formal definition of a limit as x tends to infinity ($x \rightarrow \infty$), Limit rules, the pinching theorem. (SH10 2.3, 2.5)
- **Chapter 3: Properties of continuous functions (2 hour)**
 - Combinations of continuous functions. Intermediate Value Theorem. (SH10 2.4)
 - Min-max Theorem. Relative and absolute maxima and minima (SH10 2.6, B1, B2, 4.3-4.5)
- **Chapter 4: Differentiable functions (2 hours)**
 - Definition of derivatives via tangents. Derivatives of sums, products, quotients and composites. Rates of change. Higher derivatives. (SH10 3.1, 3.2-3.5)
 - Derivatives of polynomial, rational and trigonometric functions. Implicit differentiation. Fractional powers. (SH10 3.6, 3.6, 3.7)
- **Chapter 5: The Mean Value Theorem and applications (2 hour)**
 - Mean Value Theorem and applications. (MATH1141: Proof of Mean Value Theorem) (SH10 4.1, 4.2) (SP 11)
 - L'Hôpital's rule. (SH10 11.5, 11.6) (SP 11)
- **Chapter 6: Inverse functions (2 hours)**
 - Domain, range, inverse functions. The Inverse Function Theorem. (SH10 7.1, B3) (SP 12)
 - Inverse trig functions, their derivatives and graphs. (SH10 7.7)
- **Chapter 7: Curve sketching (2 hours)**
 - Odd and even functions, periodicity, calculus. Use of domain, range, intercepts, asymptotes, periodicity, symmetry and calculus. Parametrically defined curves. (SH10 4.7, 4.8)
 - Relationship between polar and Cartesian coordinates. Sketching curves in polar coordinates. (SH10 10.2 10.3)
- **Chapter 8: Integration (5 hours)**
 - Riemann sums, the definite integral and its algebraic properties (SH10 5.1, B2) (SP 13)
 - Indefinite integrals, primitives and the two fundamental theorems of calculus. (SH10 5.2-5.5) (SP 14)
 - Integration by substitution and by parts (SH10 5.6, 8.2) (SP 18)

Integrals on unbounded domains.

Limit form of the comparison test (MATH1141: Proof of limit for of comparison test) (SH10 11.7)

- **Chapter 9: Logarithms and exponentials (2 hours)**

The natural logarithm (\ln) as a primitive of $1/x$, basic properties, logarithmic differentiation (SH10 7.2, 7.3)

Exponential function as an inverse of \ln , basic properties. Defining a^x , and logs to other bases (SH10 7.4-7.6)

- **Chapter 10: Hyperbolic functions (1 hour)**

Definitions, identities, derivatives, integrals and graphs. Inverse hyperbolic functions. (SH10 7.8, 7.9)

Course Resources

Prescribed Resources

Course Pack

The Course Pack for MATH1131/1141 contain the following items:

- 1. Algebra Notes (for MATH1131/1141),
- 2. Calculus Notes (for MATH1131/1141),
- 3. Past Exam Papers Booklet.
- 4. First Year Maple Notes.

A printed version of the course pack can be purchased from the bookshop. These items can also be downloaded from UNSW Moodle, but many students find the hardcopy more efficient for study. NB: The Course Outline can be downloaded from Moodle or the School website only which provides information on administrative matters, lectures, tutorials, assessment, syllabuses, class tests, computing, special consideration and additional assessment.

At the end of each chapter, there is a set of problems; these are your homework problems covered during Classroom Tutorials. Some problems are very easy, some are less easy but still routine, and some are quite hard. To help you decide which problems to try first, each problem is marked with an [R], [H], [X] or [V]:

- [R]: These are [R]outine problems which you should try first to consolidate new skills from this course.
- [H]: These are [H]arder and can be left until after you have done the problems marked with an [R]. Problems of this type will occur in tests and in the exam, so you do need to make an attempt at these; if you are having difficulty, please ask for help in your Classroom Tutorial!
- [X]: These are intended for students in MATH1141, and may require material not assessed in this course; MATH1131 students are e[X]empt from these questions.

- [V]: These have a [V]ideo solution on YouTube available from the course Moodle.

Recommended Resources

Staff Consultations

From Week 2, 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 first-year mathematics courses, no appointment necessary. This roster will be announced on the course Moodle and linked in the page on Moodle called "Student Life - Support Resources". See also below: <https://www.unsw.edu.au/science/our-schools/mathematics/student-life-resources/student-services/consultation-mathematics-staff>

Mathematics Drop-in Centre

The Mathematics Drop-in Centre also provides free help to students with certain first, and second, year mathematics and statistics courses. All first-year MATH courses are supported. The Drop-in Centre will be available both in-person in H13 Lawrence East Lab G12B and online on the Drop-in Centre Moodle page (via Blackboard Collaborate).

The Mathematics Drop-in Centre schedule will be available on Moodle 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. See also below: <https://www.unsw.edu.au/science/our-schools/mathematics/student-life-resources/student-services/mathematics-drop-in-centre>

Lab Consultants

For help with the Maple computing component of the first-year courses, consultants will be available via the Drop-in Centre. For more details, see below: <https://www.unsw.edu.au/science/our-schools/mathematics/student-life-resources/student-services/computing-information/maple-lab-consultants>

Textbook

S.L. Salas, E. Hille and G.J. Etgen, Calculus – One and Several Variables, any recent edition, Wiley. Note, the 10h Edition of the textbook above comes with access to the electronic resources known as WileyPlus. This electronic version provides internet access to the textbook, problems, worked solutions, test (for self assessment) and other electronic resources related to the text material. If purchased from the UNSW Bookshop, you will have access to the WileyPlus server for

one year; it is possible to renew the web access on a yearly basis or for one year, at a fee determined by the publisher. Note that these WileyPlus electronic resources are provided by the publisher John Wiley, and not by the School of Mathematics and Statistics. Any difficulty that you might experience with WileyPlus must be resolved with the publisher.

Additional Costs

None

Course Evaluation and Development

Feedback will be collected at the end of term via myExperience forms. Your feedback informs our decisions about course organisation and individual lecturer and tutor practices.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Year coordinator	Jonathan Kress		H13 Anita Lawrence Building East 3073		Via email	No	No
Administrator	Hilda Cahya		H13 Anita Lawrence Building East 3072		Via email	Yes	No
Convenor	Wolfgang Schief		H13 Anita Lawrence Building East 4069		Via email	No	Yes
Lecturer	Wolfgang Schief		H13 Anita Lawrence Building East 4069		Staff consultation schedule available on Moodle from Week 2	No	No
	Upanshu Sharma		H13 Anita Lawrence Building East 4112		Staff consultation schedule available on Moodle from Week 2	No	No
	Alan McCarth				Staff consultation schedule available on Moodle from Week 2	No	No
	David Harvey		H13 Anita Lawrence Building East 6108		Staff consultation schedule available on Moodle from Week 2	No	No

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the [UNSW Student Code of Conduct Website](#).

Academic Honesty and Plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at <https://student.unsw.edu.au/referencing>

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. 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, plagiarism and the use of AI in assessments can be located at:

- The [Current Students site](#),
- The [ELISE training site](#), and
- The [Use of AI for assessments](#) site.

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

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot

- submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: <https://student.unsw.edu.au/special-consideration>

Important note: UNSW has a “fit to sit/submit” rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- [The Current Students Gateway](#)
- [Student Support](#)
- [Academic Skills and Support](#)
- [Student Wellbeing, Health and Safety](#)
- [Equitable Learning Services](#)
- [UNSW IT Service Centre](#)
- [Science EDI Student Initiatives, Offerings and Guidelines](#)

School-specific Information

School of Mathematics and Statistics and UNSW 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 web site starting at: [The School of Mathematics and Statistics 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.

Special Consideration - Short Extension Policy

The School of Mathematics and Statistics has carefully reviewed its range of assignments and projects to determine their suitability for automatic short extensions as set out by the UNSW Short Extension Policy. Upon comprehensive examination of our course offerings that incorporate these types of assessments, we have concluded that our current deadline structures already accommodate the possibility of unexpected circumstances that may lead students to require additional days for submission. Consequently, the School of Mathematics and Statistics has decided to universally opt out of the Short Extension provision for all its courses, having pre-emptively integrated flexibility into our assessment deadlines. The decision is subject to revision in response to the introduction of new course offerings. Students may still apply for Special Consideration via the usual procedures.

Computing Lab

The main computing laboratory is room G012 of the Anita B.Lawrence Centre (formerly Red Centre). You can get to this lab by entering the building through the main entrance to the School of Mathematics (on the Mezzanine Level) and then going down the stairs to the Ground Level. A second smaller lab is Room M020, located on the mezzanine level through the glass door (and

along the corridor) opposite the School's entrance.

For more information, including opening hours, see the [computing facilities webpage](#). Remember that there will always be unscheduled periods when the computers are not working because of equipment problems and that this is not a valid excuse for not completing assessments on time.

School Contact Information

School Contact Information

Please visit the [School of Mathematics and Statistics website](#) for a range of information.

For information on Courses, please go to "Student life & resources" and either Undergraduate and/or Postgraduate and respective "Undergraduate courses" and "Postgraduate courses" for information on all course offerings.

All school policies, forms and help for students can be located by going to the "Student Services" within "Student life & resources" page. We also post notices in "Student noticeboard" for your information. Please familiarise yourself with the information found in these locations. If you cannot find the answer to your queries on the web you are welcome to contact the Student Services Office directly.

Undergraduate

E: ug.mathsstats@unsw.edu.au

P: 9385 7011 or 9385 7053

Postgraduate

E: pg.mathsstats@unsw.edu.au

P: 9385 7053

Should we need to contact you, we will use your official UNSW email address of in the first instance. **It is your responsibility to regularly check your university email account. Please use your UNSW student email and state your student number in all emails to us.**