UNSW Course Outline

MATH2501 Linear Algebra - 2024

Published on the 12 May 2024

General Course Information

Course Code : MATH2501
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Science
Academic Unit : School of Mathematics & Statistics
Delivery Mode : In Person
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

Linear algebra is a critical tool in all mathematics and its applications. For example, the output of many electrical circuits depends linearly on the input (over moderate ranges of input), and successfully correcting the trajectory of a space probe involves repeatedly solving systems of linear equations in hundreds of variables. Linear methods are vital in ecological population

models and in mathematics itself. Students have been introduced to systems of linear equations and matrices, vector spaces and linear transformations in first-year Mathematics courses without understanding all the subtleties involved.

MATH2501will review material from first year (MATH1231, MATH1241 or MATH1251) so that vector spaces and linear transformations become familiar friends rather than uneasy acquaintances. Students will learn about important geometric transformations: projections, rotations, and reflections. Students will see their applications, such as the least squares approximations, and will learn how to view many linear transformations as being made up of “stretches”; in various directions, the so-called diagonalisation process, and the more general Jordan form. The course will also introduce Jordan forms, which are used to calculate functions of matrices, such as the exponential of a matrix and hence to solve systems of linear differential equations.

The course is delivered through lectures and tutorials, which provide guidance and activities to help students refine and apply the knowledge gained in lectures.

Note: MATH2601 is the higher level version of this course, which is primarily but not exclusively intended for students aiming to complete honours in applied mathematics, pure mathematics, statistics or data science, and so aims to give students a deeper level of understanding of the course content.

Course Aims

This course aims to examine key ideas in linear algebra. The course will help students improve and develop their analytical thinking skills and their ability to communicate technical arguments clearly. Material on vector spaces and related topics that were introduced in MATH1231, MATH1241 or MATH1251 will be revised and understood in greater depth. We shall introduce more advanced work in this area including applications to geometry, data fitting and differential equations.

Relationship to Other Courses

Prerequisite: MATH1231 or MATH1241 or MATH1251 or DPST1014

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Describe the basic concepts and problems of finite dimensional linear algebra.
CLO2 : Apply the key ideas of linear algebra to geometry and differential equations.
CLO3 : Provide clear and logically written mathematical calculations and proofs.

Course Learning Outcomes	Assessment Item
CLO1 : Describe the basic concepts and problems of finite dimensional linear algebra.	• Test 1 • Test 2 • Test 3 • Final Examination
CLO2 : Apply the key ideas of linear algebra to geometry and differential equations.	• Test 3 • Final Examination
CLO3 : Provide clear and logically written mathematical calculations and proofs.	• Test 1 • Test 2 • Test 3 • Final Examination

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

The course will have five hours lectures and one hour tutorial every week.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Test 1 Assessment Format: Individual	16%	Start Date: Not Applicable Due Date: Week 4
Test 2 Assessment Format: Individual	16%	Start Date: Not Applicable Due Date: Week 7
Test 3 Assessment Format: Individual	16%	Start Date: Not Applicable Due Date: Week 10
Final Examination Assessment Format: Individual	52%	Start Date: Not Applicable Due Date: Exam Period

Assessment Details

Test 1

Assessment Overview

Run in week 4. Split as Mobius Online Quiz (6%) and a face-to-face Class test (10%)

The Online Quiz and the Class Test will cover the material from week 1 to week 3.

The Online Quiz will be available on Mobius throughout the test week (from Monday to Friday). You will have an unlimited number of attempts for each quiz. The quiz result is the result of your best attempt.

The Class Test will be scheduled during a lecture hour.

You will receive results and solutions on completing the online quiz. Marks and feedback on the paper test will be provided one week after the test.

Course Learning Outcomes

- CLO1 : Describe the basic concepts and problems of finite dimensional linear algebra.
- CLO3 : Provide clear and logically written mathematical calculations and proofs.

Detailed Assessment Description

Run in week 4. Split as Mobius Online Quiz (6%) and a face-to-face Class test (10%)

The Online Quiz and the Class Test will cover the material from week 1 to week 3.

The Online Quiz will be available on Mobius throughout the test week (from Monday to Friday). You will have an unlimited number of attempts for each quiz. The quiz result is the result of your best attempt.

The Class Test will be scheduled during a lecture hour.

You will receive results and solutions on completing the online quiz. Marks and feedback on the paper test will be provided one week after the test.

Submission notes

online + paper

Assessment information

Test 1 (Online Quiz + Class Test, week 4)

Total weight 6% + 10%; covers material of **weeks 1-3**

Online Quiz 1

opens **8am Mon 19 Jun**; closes **1pm Fri 23 Jun**

Each online quiz will be available on **Moebius** (formerly known **Maple.TA**) throughout the test week (from Monday to Friday). You will have an unlimited number of attempts with each quiz. The quiz result is the result of your best attempt.

Please note the submission closing time, **no late submissions** will be allowed.

Class Test 1

Scheduled **1pm Fri 23 Jun** (during lecture hour)

Class tests will be held during the Friday lecture hour. The class test will be designed for **40min**. The past class test papers with solutions are available on Moodle.

Assignment submission Turnitin type

Not Applicable

Test 2

Assessment Overview

Run in week 7. Split as Mobius Online Quiz (6%) and face-to-face Class Test (10%)

The Online Quiz and the Class Test will cover the material from week 4 to week 6.

The Online Quiz will be available on Mobius throughout the test week (from Monday to Friday). You will have an unlimited number of attempts with each quiz. The quiz result is the result of your best attempt.

The Class Test will be scheduled during a lecture hour.

You will receive results and solutions on completing the online quiz. Marks and feedback on the paper test will be provided one week after the test.

Course Learning Outcomes

- CLO1 : Describe the basic concepts and problems of finite dimensional linear algebra.

- CLO3 : Provide clear and logically written mathematical calculations and proofs.

Detailed Assessment Description

Run in week 7. Split as Mobius Online Quiz (6%) and face-to-face Class Test (10%)

The Online Quiz and the Class Test will cover the material from week 4 to week 6.

The Online Quiz will be available on Mobius throughout the test week (from Monday to Friday). You will have an unlimited number of attempts with each quiz. The quiz result is the result of your best attempt.

The Class Test will be scheduled during a lecture hour.

You will receive results and solutions on completing the online quiz. Marks and feedback on the paper test will be provided one week after the test.

Submission notes

online + paper

Assessment information

Test 2 (Online Quiz + Class Test, week 7)

total weight 6% + 10%; covers material of **weeks 4–6**

Online Quiz 2

opens **8am Mon 10 Jul**; closes **1pm Fri 14 Jul**

Class Test 2

Scheduled **1pm Fri 14 Jul** (during lecture hour)

Online Quizzes

Each online quiz will be available on **Moebius** (formerly known **Maple.TA**) throughout the test week (from Monday to Friday). You will have an unlimited number of attempts with each quiz. The quiz result is the result of your best attempt.

Please note the submission closing time, **no late submissions** will be allowed.

Class Tests

Class tests will be held during the Friday lecture hour. The class test will be designed for **40min**. The past class test papers with solutions are available on Moodle.

Assignment submission Turnitin type

Not Applicable

Test 3

Assessment Overview

Run in week 10. Split as Mobius Online Quiz (6%) and face-to-face Class Test (10%)

The Online Quiz and the Class Test will cover the material from week 7 to week 9.

The Online Quiz will be available on Mobius throughout the test week (from Monday to Friday). You will have an unlimited number of attempts with each quiz. The quiz result is the result of your best attempt.

The Class Test will be scheduled during a lecture hour.

You will receive results and solutions on completing the online quiz. Marks and feedback on the paper test will be provided one week after the test.

Course Learning Outcomes

- CLO1 : Describe the basic concepts and problems of finite dimensional linear algebra.
- CLO2 : Apply the key ideas of linear algebra to geometry and differential equations.
- CLO3 : Provide clear and logically written mathematical calculations and proofs.

Detailed Assessment Description

Run in week 10. Split as Mobius Online Quiz (6%) and face-to-face Class Test (10%)

The Online Quiz and the Class Test will cover the material from week 7 to week 9.

The Online Quiz will be available on Mobius throughout the test week (from Monday to Friday). You will have an unlimited number of attempts with each quiz. The quiz result is the result of your best attempt.

The Class Test will be scheduled during a lecture hour.

You will receive results and solutions on completing the online quiz. Marks and feedback on the paper test will be provided one week after the test.

Submission notes

online + paper

Assessment information

Test 3 (Online Quiz + Class Test, week 10)

total weight: 6% + 10%; covers material of **weeks 7–9**

Online Quiz 3

opens **8am Mon 31 Jul**; closes **1pm Fri 4 Aug**

Class Test 3

Scheduled **1pm Fri 4 Aug** (during lecture hour)

Online Quizzes

Each online quiz will be available on **Moebius** (formerly known **Maple.TA**) throughout the test week (from Monday to Friday). You will have an unlimited number of attempts with each quiz. The quiz result is the result of your best attempt.

Please note the submission closing time, **no late submissions** will be allowed.

Class Tests

Class tests will be held during the Friday lecture hour. The class test will be designed for **40min**. The past class test papers with solutions are available on Moodle.

Assignment submission Turnitin type

Not Applicable

Final Examination

Assessment Overview

The final examination will be held during the official exam period. The exam will last for 2 hours and will cover the entire course material.

You may inspect your script under the usual UNSW and School processes. Solutions and general comments may be provided after any supplementary exam has been completed, or results are

released whichever occurs later.

Course Learning Outcomes

- CLO1 : Describe the basic concepts and problems of finite dimensional linear algebra.
- CLO2 : Apply the key ideas of linear algebra to geometry and differential equations.
- CLO3 : Provide clear and logically written mathematical calculations and proofs.

Detailed Assessment Description

The final examination will be held during the official exam period. The exam will last for 2 hours and will cover the entire course material.

You may inspect your script under the usual UNSW and School processes. Solutions and general comments may be provided after any supplementary exam has been completed, or results are released whichever occurs later.

Submission notes

paper

Assessment information

Final Examination

The examination will be held during the exam period. The examination branch will release the date and time of the examination during the term. The past exam papers with solutions are available on Moodle.

Assignment submission Turnitin type

Not Applicable

General Assessment Information

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Topic	Week 1 • Welcome • Systems of Linear Equations Solutions to system of linear equations How to find General Solution to SLE • Matrix Operations Matrix Notations and Conventions Matrix Addition and Scaling Matrix Multiplication Identity Matrix Matrix Inverse Finding Matrix Inverse Matrix Transpose Special Matrices • Vector Spaces Definition Primary Examples of Vector Spaces Vector Subspaces Matrix Nullspace, Matrix Col(umn) space, Span
Week 2 : 3 June - 9 June	Topic	Week 2 • Linear Dependence, Spanning, Basis Linear (In)dependent Set Spanning Set Basis Dimension Testing Linear (In)dependence, Spanning and Basis Standard Bases Coordinate Vector • Linear Transformations Definition and Examples Matrix of Linear Map (Standard Bases) Matrix of Linear Map (Arbitrary Bases) General definition of the Matrix of Linear Map – How to find Matrix of Linear Map
Week 3 : 10 June - 16 June	Topic	Week 3 Short/Public Holiday • Dot Product Dot Product, Length, Angle. Cauchy-Schwartz Inequality Orthogonal Complements and (Orthogonal) Projections (dimension 2) Orthogonal Complements and (Orthogonal) Projections (dimension 3) Orthogonal Complements and (Orthogonal) Projections, (any dimension)
Week 4 : 17 June - 23 June	Topic	Week 4 Short/Test Week • Orthogonal and Orthonormal Bases Definition The Gram-Schmidt Process QR Factorisation • Least Square Method
Week 5 : 24 June - 30 June	Topic	Week 5 • Inner Product • Determinant (part 1) Definition Determinant is Polylinear Function of Columns and Rows Further Row/Columns properties of Determinant • Determinant (part 2) Determinant and Transpose Determinant and Matrix Multiplication Determinant and Linear Dependence Cramer's Rule: Determinant and System of Linear Equations Determinant and Inverse • Eigenvalues and eigenvectors Finding eigenvalues and eigenvectors Diagonalisation Diagonalisation in case of less than dimension number of eigenvalues Eigenvalues and trace and determinant.
Week 6 : 1 July - 7 July	Topic	Week 6 Flexibility Week
Week 7 : 8 July - 14 July	Topic	Week 7 Short/Test Week • Orthogonal Maps Definition Orthogonal Matrix and Determinant Orthogonal Matrix and Eigenvalues and Eigenvectors Matrix of Rotation in R2 When Orthogonal Matrix is a R2 Rotation When Orthogonal Matrix is NOT a R2 Rotation Rotation followed by Reflection is pure Reflection Standard Rotations in R3 Standard Reflections in R3 Reflection construction. • Quadratic Expressions
Week 8 : 15 July - 21 July	Topic	Week 8 • Cayley-Theorem and Minimal Polynomial Companion Matrix Matrix and its Characteristic Polynomial (Cayley-Hamilton Theorem) Matrix Exponents The vector space C[A] Minimal Polynomial • Jordan Forms - Similar Matrices • Jordan Forms Direct Sums J Factor Identification
Week 9 : 22 July - 28 July	Topic	Week 9 • Jordan Forms - J Factor Identification - Examples • Jordan Forms - P Factor Identification • Application of Jordan Forms to Matrix Powers and Matrix Exponents
Week 10 : 29 July - 4 August	Topic	Week 10 Short/Test Week • Application of Jordan Forms to PDE

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Resources

Prescribed Resources

The resources for this course are published on Moodle page of this course.

Recommended Resources

The material of this course beyond the first-year Algebra Notes is covered in depth in this textbook

"Linear Algebra" Stephen H. Friedberg ; Arnold J Insel ; Lawrence E Spence ;
Englewood Cliffs, N.J ; Prentice-Hall, c1979

Course Evaluation and Development

We value students' feedback. Students will have an opportunity to contribute their feedback at the end of this course during MyExperience survey.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Mircea Voine agu		RC 6112		Monday 1-2pm	No	Yes

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 Plagarism

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

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.**