THE UNIVERSITY OF SYDNEY
Semester 1, 2017

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Information Sheet for **MATH1902 Linear Algebra (Advanced)**

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**Websites:** It is important that you check both the Junior Mathematics website and the MATH1902 website regularly.

Junior Mathematics webpage: `http://www.maths.usyd.edu.au/u/UG/JM/`
MATH1902 webpage: `http://www.maths.usyd.edu.au/u/UG/JM/MATH1902`

Both sites may be accessed through the Learning Management System (Blackboard):

`https://elearning.sydney.edu.au`.

Important announcements relating to Junior Mathematics are posted on the Junior Mathematics page. On the MATH1902 page you will find online resources and other useful links. Announcements regarding assessment tasks will be made on this page at various times throughout the semester.

**Lectures:** There are 2 different lecture streams. You should attend one stream (that is, two lectures per week), as shown on your personal timetable.

| Times | Location | Lecturer |
|---|---|---|
| 11 am Mon<br>11 am Tue | Chemistry LT 1<br>New Law LT 101 | Prof Holger Dullin |
| 11 am Mon<br>11 am Tue | ABS Case Study LT 2080<br>ABS Case Study LT 2140 | Alexander Kerschl |

Lectures run for 13 weeks. The first lecture will be on Monday 6 March. The last lecture will be on Tuesday 6 June.

**Consultation times:** Consultation times will be posted on the MATH1902 webpage.

**Tutorials:** Tutorials (one per week) start in Week 1. You should attend the tutorial given on your personal timetable. Attendance at tutorials will be recorded.

**Tutorial and exercise sheets:** The question sheets for a given week will be available on the MATH1902 webpage. Solutions to tutorial exercises for week $n$ will usually be posted on the web by the afternoon of the Friday of week $n$.

**Textbook:** *A First Course in Linear Algebra*, by David Easdown. Available from the Co-op Bookshop.

**Assessment:** Your final raw mark for this unit of study will be calculated as follows:

70%: Exam at end of Semester 1.
10%: Quiz 1 mark (using the better mark principle).
10%: Quiz 2 mark (using the better mark principle).
5%: Assignment 1 mark.
5%: Assignment 2 mark.

The *better mark principle* means that for each quiz, the quiz counts if and only if it is better than or equal to your exam mark. If your quiz mark is less than your exam mark, the exam mark will be used for that portion of your assessment instead. For example, if your quiz 1 mark is better than your exam mark while your quiz 2 mark is worse than your exam mark, then the exam will count for 80%, quiz 1 will count for 10%, and the assignments will count for 10% of your overall mark. The assignment marks count for 10% regardless of whether they are better than your exam mark or not.

Final grades are returned within one of the following bands:

**High Distinction (HD), 85–100:** representing complete or close to complete mastery of the material; **Distinction (D), 75–84:** representing excellence, but substantially less than complete mastery; **Credit (CR), 65–74:** representing a creditable performance that goes beyond routine knowledge and understanding, but less than excellence; **Pass (P), 50–64:** representing at least routine knowledge and understanding over a spectrum of topics and important ideas and concepts in the course.

A student with a passing or higher grade should be well prepared to undertake further studies in mathematics. Students intending to continue with further advanced units of study should be aiming to obtain a credit or higher.

**Examination:** There is one examination of 1.5 hours' duration during the examination period at the end of Semester 1. Further information about the exam will be made available at a later date on the website.

**Quizzes:** Quizzes will be held during tutorials. You must sit for the quiz during the tutorial in which you are enrolled, unless you have a Permission Slip from the Student Services Office, issued only for verifiable reasons. Otherwise, your quiz mark may not be recorded.

**Assignments:** There are two assignments, which must be submitted electronically, **as PDF files only**, in Turnitin (an internet-based plagiarism-prevention service), via the Learning Management System (Blackboard) website by the deadline. Note that your assignment will not be marked if it is illegible or if it is submitted sideways or upside down. It is your responsibility to check that your assignment has been submitted correctly.

**Assessment and feedback schedule:**

| Task | Available | Deadline/date | Latest extension* | Feedback |
|---|---|---|---|---|
| Assignment 1 | Fri 10 Mar | 11:59 pm Mon 20 Mar | 11:59 pm Mon 27 Mar | 9 am Wed 29 Mar |
| Quiz 1 | | 5 Apr (Week 5) | | 12 Apr (Week 6) |
| Assignment 2 | Fri 28 Apr | 11:59 pm Mon 8 May | 11:59 pm Mon 15 May | 9 am Wed 17 May |
| Quiz 2 | | 24 May (Week 11) | | 31 May (Week 12) |

* Extensions for assignments are only possible for students registered with Disability Services or applying for Special Consideration or Special Arrangements.

**Special consideration and special arrangements:** While studying at the University of Sydney, you may need to apply for special consideration or special arrangements as follows:

> Special consideration may be granted to students where well-attested illness, injury, or misadventure occurs to them (or someone they have carer's responsibility for) during the semester or the exam period. Special arrangements may be granted for essential community commitments. Further information on eligibility, document requirements, and how to apply is available at `http://sydney.edu.au/science/cstudent/ug/forms.shtml#special_consideration`. Applications must be made using the University's formal application process.
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> Final examinations will be held in the formal examination period. Students affected by illness, injury or misadventure may lodge a request for Special Consideration to sit a replacement examination in the formal Replacement Examination period (week 18).
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> If you are registered with Disability Services and would like to have adjustments applied to the replacement examination, you are required to amend your Academic Plan with Disability Services specifically for this replacement examination. This needs to be done as soon as you are notified of award of the replacement opportunity. If you have not done so, you will be allowed to sit the replacement, but under unadjusted conditions.

You should *not* submit an application of either type

- if you are absent from a tutorial and there is no assessment associated with the missed tutorial, or
- if you miss a quiz, since the better mark principle applies.

The assessment category for the assignments is "Submitted Work".

**Any questions?** Before you contact us with any enquiry, please check the FAQ page:

`http://www.maths.usyd.edu.au/u/UG/JM/FAQ.html`.

**Where to go for help:** For administrative matters, go to the *Student Services Office, Carslaw 520*. For help with mathematics, see your lecturer, your tutor, a duty tutor, or use the Ed discussion forum (`https://edstem.com.au`). Lecturers guarantee to be available during their indicated office hours, but may be available at other times as well. You may also email questions about the subject to `MATH1902@maths.usyd.edu.au`. Ensure that any emails that you send to this address contain your name and SID, because anonymous emails will be ignored.

**Aims and learning outcomes:** Advanced units of study (MATH1901 and MATH1902) in mathematics in Semester 1 build on the broad foundations of calculus and precalculus learnt at school, integrating them with new and novel concepts in linear algebra. Students should start to gain an appreciation of the power and beauty of mathematics that evolved over 2000 years yet is indispensable to our modern way of life. Calculus and linear algebra are two cornerstones of mathematics, and over the course of one semester students taking both units start to see these subjects intertwine to form the backbone of almost all applications of mathematics to physical and biological sciences and engineering. (The first continuation is in Semester 2 of the junior year, studying integral calculus and modelling in MATH1903, and then, subsequently, a spectacular explosion of ideas coming together in the first semester of the intermediate year, studying vector calculus in MATH2961.)

By the end of the semester, students should be able to:

- apply mathematical logic and rigour to solving problems;
- express mathematical ideas coherently in written and oral form;
- demonstrate fluency in manipulating complex numbers, functions of one or two variables, limits, differentiability and polynomial approximations;
- demonstrate fluency in vector and matrix arithmetic, and their applications to solving systems of equations.

In particular, students taking MATH1902 should be able to:

- perform arithmetic of geometric vectors in the plane and in space, with applications to classical problems in geometry;
- perform and manipulate dot, cross and triple products and vector projections, with applications to lines and planes in space;
- develop fluency with systems of equations and the methods of Gaussian and Gauss-Jordan elimination;
- perform matrix arithmetic, calculate matrix inverses, determinants, eigenvalues and eigenvectors;
- develop fluency with methods of diagonalisation and applications;
- become conversant with important classical results, such as the Fundamental Theorem of Algebra and the Cayley–Hamilton Theorem, that underlie more advanced topics in linear algebra.

**Proposed week-by-week outline:**

| Week | Topics |
|---|---|
| 1 | Introduction to linear algebra. Geometric vectors. Properties and applications to geometry. |
| 2 | Unit and hat vectors. Cartesian form and component-wise operations. Parallel vectors, linear dependence and independence. |
| 3 | Dot products, geometric and algebraic forms. Projections, scalar, vector and orthogonal components. |
| 4 | Cross products, geometric and algebraic forms. The right-hand rule, properties and applications to geometry. Revision leading up to the first quiz. |
| 5 | Lines and planes in space. Normal vectors and cross products. Parametric, vector and cartesian equations. |
| 6 | Systems of linear equations. Row operations and Gaussian elimination. Reduced row-echelon form and Gauss-Jordan elimination. |
| 7 | Matrices, row and column vectors. Matrix operations and properties. Sigma notation and proofs. |
| 8 | Elementary matrices. Inverse matrices, properties and applications. |
| 9 | Polynomials and the Fundamental Theorem of Algebra. Introduction to determinants. |
| 10 | Determinants, rank of matrices, invertibility criteria, properties and applications. |
| 11 | Eigenvalues and eigenvectors. Characteristic equations and the Cayley–Hamilton Theorem. |
| 12 | Diagonalisation and applications. Introduction to Markov processes. Introduction to real and complex Jordan forms. |
| 13 | The Fundamental Theorem of Algebra. Revision. |