THE UNIVERSITY OF SYDNEY
Semester 1, 2011

---

Information Sheet for **MATH1002 Linear Algebra**

---

**Websites**
It is important that you check both the MATH1002 website and the Junior Mathematics website regularly. Both sites may be accessed through WebCT, or directly.

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

MATH1002 webpage: `http://www.maths.usyd.edu.au/u/UG/JM/MATH1002`

Important announcements relating to Junior Mathematics are posted on the Junior Mathematics page.
On the MATH1002 page you will find on-line resources and other useful links. Announcements regarding assessment tasks will be made on this page at various times throughout the semester. Make sure you check the page weekly.

**Lectures**
There are 3 different lecture streams. You should attend one stream (that is, two lectures per week), as shown on your personal timetable.

| Times | Location | Lecturer |
|---|---|---|
| 8 am Mon & Tue | E Ave Aud | Weeks 1–6: A/Prof H Dullin, Carslaw room 714<br>Weeks 7–13: Dr Z Zhang, Carslaw room 620 |
| 11am Mon & Tue | E Ave Aud | Dr R Crossman, Carslaw room 527 |
| Mon 11 am<br>& Wed 11am | Wallace<br>E Ave Aud | Weeks 1–6: Mr A Crisp, Carslaw room 807<br>Weeks 7–13: Dr J Hillman, Carslaw room 617 |

Lectures run for 13 weeks, and the last lecture will be on Tuesday 31 May, or Wednesday 1 June.

**Consultation times**
Lecturers are available for consultation as follows:

| | |
|---|---|
| A/Prof Dullin: | Mondays (weeks 1–6), 1–2 pm, Carslaw room 714. |
| Dr Zhang: | Thursdays (weeks 7–13), 1–2 pm, in Carslaw room 620. |
| Dr Crossman: | Tuesdays (weeks 1–13), 1–2 pm, in New Law seminar room 444. |
| Mr Crisp: | Wednesdays (weeks 1–6), 1–2 pm, in Carslaw room 357. |
| Dr Hillman: | Wednesdays (weeks 7–13), 1–2 pm, in Carslaw room 617. |

Note: You may attend any of these consultations, irrespective of which lecture stream you attend.

**Tutorials**
Tutorials (one per week) start in week 1. There is no tutorial in week 13. You should attend the tutorial given on your personal timetable. Attendance at tutorials will be recorded. Your attendance cannot be recorded unless you attend the tutorial in which you are enrolled. Your attendance record will be taken into account in the event that you apply for special consideration at any stage.

**Tutorial sheets**
The tutorial question sheets for a given week will be available on the MATH1002 web page. **You must print out the current week's tutorial sheet from the web, and take it to your tutorial with you.** Solutions to tutorial exercises for week $n$ will usually be posted on the web by Friday of week $n$.

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

| | |
|---|---|
| 65%: | Exam at end of semester 1. |
| 30%: | Quiz mark. |
| 5%: | Assignment mark. |

Your final raw mark is then scaled to produce your final mark. Marks are scaled so that the distribution of grades is consistent with the quality of the class, and the difficulty of the unit, as required by the University.

**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.

**Quizzes**
Two quizzes will be held during tutorials, in the **weeks beginning 4 April and 9 May**. Each quiz is worth 15% of your final raw mark. You must sit for the quiz during the tutorial in which you are enrolled. Your quiz mark will not be recorded if you sit for the quiz in a tutorial in which you are not enrolled.

**Assignments**
One assignment will be marked, and will be worth 5% your final raw mark. The assignment will be due on **Thursday 19 May**. Please see page 25 of the Junior Mathematics Handbook for details relating to the submission of assignments.

**Text book**
David Easdown. *A First Course in Linear Algebra.* Available from the Co-op Bookshop.

**Where to go for help**
For administrative matters, go to the **Student Office, Carslaw room 520.**
For help with mathematics, see one of the MATH1002 lecturers. Lecturers guarantee to be available during their indicated consultation hour, but may well be available at other times as well.
If you are having difficulties with mathematics due to insufficient background, you should go to the Mathematics Learning Centre (Carslaw room 455).

**Objectives**
The objectives of this unit are:

- to introduce the concept of a vector, both as an abstract and geometric construct;
- to introduce the basic concepts of linear algebra – systems of linear equations, matrices, determinants, eigenvalues and eigenvectors;
- to illustrate the power and beauty of mathematics as a tool for expressing, thinking about, and solving problems;
- to improve your ability to think logically, analytically, and abstractly;
- to enhance your problem-solving skills.

In addition, this unit provides students with a solid foundation for further studies in mathematics and/or other scientific disciplines.

**Outcomes**
Students who successfully complete this unit will be able to demonstrate competency in:

- applying mathematical logic and rigour to solving problems;
- representing vectors both algebraically and geometrically in $\mathbb{R}^2$ and $\mathbb{R}^3$, and being able to perform arithmetic with them;
- using vectors to solve classical geometric problems;
- performing and manipulating dot and cross products;
- setting up systems of linear equations;
- solving systems of linear equations using Gaussian elimination;
- performing matrix arithmetic and calculating matrix inverses and determinants;
- finding eigenvalues and eigenvectors;
- diagonalising a matrix;
- expressing mathematical ideas and arguments coherently in written form.

**Week-by-week outline**

| Week | Topics |
|---|---|
| 1 | Geometric vectors in the plane and space. Scalar multiples. Position vectors. Parallelogram, commutative and associative laws of vector addition. Zero vector. Negative vectors and subtraction. Properties and applications to geometry. |
| 2 | Unit vectors. Hat of a vector. Cartesian form and component-wise operations. Parallel vectors and linear independence of two vectors. |
| 3 | Dot product: geometric and algebraic formulae. Commutativity of dot product. Distributivity. Vector projection. Scalar components. Vector components. Orthogonal components. |
| 4 | Cross product: geometric and algebraic formulae. Anti-commutativity of cross product. Distributivity. Area of a parallelogram inscribed by two vectors. |
| 5 | Lines and planes in space. Parametric vector equation, parametric scalar equations and cartesian equations of a line. Vector and cartesian equations of a plane. Normal vector to a plane. |
| 6 | Linear equations. Systems of linear equations. Solutions of a system. Homogeneous systems. Inconsistent systems. |
| 7 | Augmented matrices. Elementary row operations. Row echelon form and Gaussian elimination. Leading variables and back substitution. Reduced row echelon form and Gauss-Jordan elimination. |
| 8 | Matrices. Row and column vectors. Matrix addition, subtraction and multiplication. Scalar multiplication. Zero matrix. Identity matrix. Negative of a matrix. Properties of matrix operations. |
| 9 | Inverse of a matrix. Determinant of a two-by-two matrix. Powers of a matrix. Formula for inverse of a two-by-two matrix. Using augmented matrices to invert a matrix. Using the inverse matrix to solve a system of equations. |
| 10 | Determinants. Expansion along any row or down any column. Determinant method for cross products. Multiplicative property of determinants. Invertibility criterion using determinants. Effect on determinants of using row and column operations. |
| 11 | Eigenvalues and eigenvectors of a matrix. Eigenspace corresponding to an eigenvalue. Characteristic polynomial of a matrix. Solving homogeneous systems to find eigenvectors. |
| 12 | Diagonal matrices. Diagonalisation and applications. |
| 13 | Revision. |