

THE UNIVERSITY OF SYDNEY
Semester 1, 2011

Information Sheet for **MATH1901 Differential Calculus (Advanced)**

Websites

It is important that you check both the MATH1901 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/>

MATH1901 webpage: <http://www.maths.usyd.edu.au/u/UG/JM/MATH1901>

Important announcements relating to Junior Mathematics are posted on the Junior Mathematics page.

On the MATH1901 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

Times	Location	Lecturers	Consultation
8 am Thurs & Fri	Chemistry LT1	Dr C Cosgrove Carslaw room 716	Thursdays, 1-2pm

Lectures run for 13 weeks, and the last lecture will be on Friday 3 June.

Tutorials

Tutorials (one per week) start in week 2. 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 sheets are printed in the back of the course notes. **You should take your notes to your tutorial, since you will need to have the current week's sheet with you at your tutorial.** The tutorial sheets will also be available on the MATH1901 web page.

Solutions to tutorial exercises for week n will usually be posted on the web on the Tuesday of week n .

Assessment

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

70%: Exam at end of semester 1.

20%: Quiz mark.

10%: 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 on **Monday 11 April** and **Monday 16 May**. (MATH1906 students will do the quizzes on Thursday 14 April and Thursday 19 May.) Each quiz is worth 10% 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

Two assignments will be set and marked. Each assignment is worth 5% of your final raw mark. Assignments will be due on **Tuesday 19 April** and **Tuesday 24 May**. Please see page 25 of the Junior Mathematics Handbook for details relating to the submission of assignments.

Course notes

J. Henderson. *MATH1901 and MATH1906: Differential Calculus (Advanced)*. Available for purchase from Kopystop, 55 Mountain St, Broadway.

See the Junior Mathematics Handbook for other references.

Where to go for help

For administrative matters, go to the **Student Office, Carslaw room 520**.

For help with mathematics, see your lecturer, or your tutor. Lecturers guarantee to be available during their indicated office hour, but may well be available at other times as well.

Aims and Learning Outcomes

Differential Calculus (MATH1901) is the beginning of a natural hierarchy of mathematics units of study, the first continuation being MATH1903 (Integral Calculus and Modelling) in Semester 2, followed in the intermediate year by MATH2961 and MATH2962, which also build upon Linear Algebra (MATH1902).

The unit of study begins with an introduction to the field of complex numbers, where, for example, every quadratic equation has two roots or a double root and every number except zero has a logarithm. All of modern mathematics and its applications to physics and engineering would grind to a screeching halt without complex numbers.

Next, the familiar notation for functions gets an upgrade. Then the main theme of the unit is introduced, namely, the concept of limit. Limits will be treated rigorously (the “epsilon-delta” definition), although enough rules will be developed to allow the student to calculate and manipulate limits without having to reach for the epsilons and deltas except on special occasions.

With the concept of limit in place, one can now start endowing functions with nice properties such as continuity or differentiability, and derive consequences of these properties. In particular, a strong form of l’Hôpital’s rule for calculating certain types of limits will be proved. You are now in the land of differential calculus.

The later part of the unit deals with the powerful theory of Taylor polynomials and the extension of continuity and differentiability to functions of two or more variables and their graphs in space, borrowing some vector theory from MATH1902.

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

- apply mathematical logic and rigour to solving problems and express mathematical ideas coherently in written and oral form;
- demonstrate fluency in manipulating complex numbers, functions of one or more variables, inverse functions, limits, derivatives, maxima and minima, and polynomial approximations;
- understand and know how to use the theorems that apply specifically to continuous functions (intermediate value theorem, extreme value theorem) and to differentiable functions (chain rule, Rolle’s theorem, mean value theorem, l’Hôpital’s rule, Taylor’s formula with remainder);
- understand the differential calculus of functions of two or more variables, continuity, partial differentiation, directional differentiation, full differentiability, chain rule, implicit differentiation;
- be able to represent surfaces in space by contour lines (level curves) in the plane, and be able to construct tangent planes on surfaces as well as tangent lines on surfaces in given directions and in the steepest direction.

Proposed week-by-week outline

Week	Topics
1	Complex numbers in Cartesian and polar form. Complex powers and De Moivre's Theorem.
2	n th roots. The complex exponential function. Representing complex functions.
3	Injective and bijective functions. Inverse functions. Hyperbolic functions.
4	Limits and the limit laws.
5	Continuity. Intermediate Value Theorem.
6	Differentiability. Rolle's Theorem.
7	Mean Value Theorem. L'Hopital's Rule.
8	Taylor polynomials.
9	Curves and surfaces in 3D space. Functions of 2 variables. Level curves.
10	Limits of functions of 2 variables. Partial derivatives. Tangent planes.
11	Linear approximations. Chain rule for functions of 2 variables.
12	Implicit differentiation. Directional derivative and gradient.
13	Revision.