M1M1: Mathematical Methods I (Analytical)

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(i) Eight problem sets will be handed out as the material is covered. Solution sets will be available by the end of term.

(ii) There will be **three** lectures in M1M1 in each week of the Autumn term (implying a total of approximately 30 lectures). In addition, every week there will be two "Problem Solving Classes" on Tuesdays at 9am and Fridays at 11am in Rooms 341, 342, 343 and 344.

(iii) There will be 3 **Progress Tests** of 50 minutes duration throughout the term on the following dates:

Test 1: Friday October 28th at 2pm

Test 2: Friday November 18th at 2pm

Test 3: Friday December 9th at 2pm

(iv) In common with other first-term courses in Year 1, there will also be a "January Test" on M1M1 in January 2005 of $1\frac{1}{2}$ hours duration.

(v) The allocation of credit for the **analytical component** of this course is as follows: June Examination 90 %; January Examination 5 %; Progress Tests 5 %. Students must also take a separate **computational component** in the first term (M1M1Comp).

(vi) Weekly office hour – Monday 1-2 pm (612 Huxley)

(vii) There is a website for the course. Go to www.ma.ic.ac.uk/~dgcrowdy and click on "Classes". Problem sheets are downloadable from here as PDF files (solution sets will become available in due course) as well as past January Test and Summer Examination papers.

Recommended texts

There is no ideal textbook for this course but the following three might be helpful:

1. *Calculus: Single variable*, R.T. Smith and R.B. Minton (McGraw Hill).

   This book is very accessible, is aimed at mathematicians (as opposed to engineers) and contains lots of examples. There is also an associated website offering an "online study aid" service.
   Students can register at `register.mcgraw-hill.com`.

2. *Short Calculus*, S. Lang, (Springer-Verlag)

   This is a very concise presentation of basic calculus aimed at young mathematicians. Its virtue is its uncluttered style. I would suggest that this is a good book to read if you are already confident with the material after A-Level. The book may provide you with a fresh spin on material you have already seen, and thus give you better insight. Warning: there are very few examples/exercises.

3. *Engineering Mathematics*, K.A. Stroud, (Palgrave).

   This book is aimed at engineers and is often recommended to Imperial engineering undergraduates during their first year mathematics courses. It is very accessible and its aim is to train you to be fluent in mathematical manipulation (which, actually, is also the aim of M1M1). It is crammed with examples (and solutions). It also contains lots of material that won't be needed in this course (some of these extra topics will be treated next term in M1M2).

OUTLINE OF SYLLABUS

(1) **Functions**. Basic notion of a function. Even and odd functions. Inverse functions. Idea of special functions defined by series expansions (especially trigonometric and exponential functions). Inverse trigonometric functions and the logarithmic function.

(2) **Limits**. Basic properties. Continuous and discontinuous functions.

(3) **Differentiation**. Definition of the derivative using limits. Differentiation from first principles. Logarithmic and implicit differentiation. Higher-order derivatives. Leibniz's formula. Stationary points and points of inflexion. Curve sketching. Polar coordinates.

(4) **Series expansions**. Infinite power series. Convergence of series. Ratio test. Taylor and Maclaurin series. L'Hopital's rule. Mean value theorem. Taylor's theorem. Small errors.

(5) **Complex numbers**. Definition. The complex plane. Standard form and polar representation of a complex number. Euler's formula. De Moivre's theorem. Complex logarithm and exponential. Solutions of complex equations.

(6) **Integration**. Definite and indefinite integrals. Fundamental theorem of calculus. Integration by substitution. Integration by parts. Use of partial fractions in computing integrals. Improper integrals.

(7) **First order ordinary differential equations**. Separable equations. Homogeneous equations. First-order linear equations. Constant coefficient equations. Euler-type equations. Simple applications.