# HANDBOOK FOR THE UNDERGRADUATE MATHEMATICS COURSES

**Issued September 2006**

# Getting Started

## Welcome

Welcome to Oxford and to Oxford mathematics courses.

You arrive at a very exciting time when, through the publicity surrounding several government enquiries, understanding of the importance and intellectual power of mathematics is much increased. Interest in the progress on the important outstanding problems in mathematics is such that it is reported in the national press. More people are aware that mathematics is a language of science and technology. New scientific problems are being tackled through mathematics, particularly the biological and environmental problems that face us today. The mathematical skills you learn through your degree course will be highly valued and open doors to satisfying careers. We, the Faculty, are here to share with you the excitement and intellectual satisfaction gained through the study of mathematical ideas.

'There is much here to excite admiration and perplexity.'

Lord Rayleigh

G. L. Luke
Chairman,
Faculty of Mathematics

## Using this Handbook

This **Handbook** is intended as a guide and reference for you throughout your Mathematics course at Oxford. It supplements the material printed in the **Examination Regulations**. The **Handbook** defines the syllabus, provides you with information to help you understand the processes and procedures of the Faculty and about the Mathematical Institute and the other facilities such as libraries and computers to which you have access. You are supplied with the **Handbook** at the beginning of your course and will be informed by your tutors when you should collect supplements to it - such as the course synopses for each year of your course. All this material is published on the Mathematical Institute website.

The **Handbook** also gives you some information about colleges in relation to the way your Mathematics course works.

**This is primarily the Course Handbook for the single subject Mathematics courses. Much of what is said is also relevant to the Mathematics parts of the joint courses (Mathematics & Computer Science, Mathematics & Philosophy and Mathematics & Statistics). However, students on the joint courses should also consult the handbooks designed specifically for these courses.**
The handbook, and other information about the Mathematics & Computer Science course, can be found on the Computing Laboratory website.
The handbook, and other information about the Mathematics & Philosophy course, can be found on the Mathematical Institute website.
The handbook, and other information about the Mathematics & Statistics course, can be found on the Statistics Department website.

## Other Paperwork

The general regulations describing the examination structure are published by the University in the **Examination Regulations**, sometimes called "The Grey Book", which is the authority on matters concerning University examinations and their conduct. In 2006-07 this book should be published on the University website. Amendments to the syllabus and course structure are carefully regulated by the University. If changes are made which affect you then you will be informed. There is a long-standing convention that the syllabus cannot be changed to your disadvantage once you have started studying for the examination concerned, provided that you take your examinations at the normal time.

This **Handbook** contains both the **Syllabus** and **Lecture Synopses** for the first-year lecture courses. The **synopses** reflect the intended content of the corresponding lecture courses, but are not the formal syllabus for the Examinations. The lecturer may include material which enhances the syllabus and will not be examined.

At the start of each year the Mathematics Faculty produces the syllabus for that year's examination and synopses of lectures: you should obtain these, usually from the Mathematical Institute—your college tutors will advise you when to do so—for each year of your course as appropriate. They are also available electronically from https://www.maths.ox.ac.uk/current-students/undergraduates/handbooks-synopses/.

You should note that, as part of the **Lecture Synopses**, supporting **Reading Lists** are issued.

Each term you may receive through your college tutor a copy of the **Lecture List** giving the titles, times, and places of all the lectures being given in Mathematics courses that term. **These lecture lists are also available electronically from the web site**.

For certain courses (e.g., the first-year Maple course) you will be provided with a **Guide** to that course.

Many—probably all—students will provide themselves with copies of **Examination Papers** from previous years. Those for the years up to and including 1999 can be obtained from the Examination Schools, and those from 2000 can be accessed on the University Intranet. Unofficial versions of papers are also on the Mathematical Institute Website. Some students buy Examination Papers from their predecessors. A word of caution: these papers do not define the examination syllabus and most older papers will have been set on a different syllabus! As well as using them as a source of exercises, you may want to look at them in conjunction with the corresponding **Examiners' Reports**: for the years up to and including 1999 these are deposited in college libraries; and from 2000 are posted on the Mathematical Institute Website.

In addition to these subject-specific guides you will also receive in one form or another, but probably as a **College Handbook**, detailed guidance about your own college's regulations and requirements. You will also receive **Essential Information for Students** (the **Proctors' and Assessor's Memorandum**). This is also available electronically: www.admin.ox.ac.uk/proctors/info/index.shtml.

## How to Study

Although there are many ways of organising your time and arranging your study, the considered advice of one successful mathematician is clear: "[You] would be wise to find out what the usual methods are and give them a prolonged trial before finally committing [your]self. There can be powerful illusions on such points . . . ".[1]

You are strongly recommended to read the notes *How do Undergraduates do Mathematics?* prepared by Charles Batty with the assistance of Nick Woodhouse. These are available for purchase at the Mathematical Institute or can be downloaded from the Maths website at:
http://www.maths.ox.ac.uk/current-students/undergraduates/study-guide/.

You may also like to see what is said in another place; it is recommended that you visit Dr Körner's homepage at http://www.dpmms.cam.ac.uk/∼ twk/ (see below) and read his advice on *How to listen to a Maths Lecture*.

## Email

You will be allocated a college email account. Important information about your course will be sent to this account. If you do not plan to read it regularly you should ensure that you arrange for mail to be forwarded to an account which you do read regularly. You are asked to bear in mind that lost email is the students' responsibility should they choose to forward email to a system outside the university.

[1] J E Littlewood, *The Mathematician's Art of Work*, in *Littlewood's Miscellany*, CUP.

## Useful 'Web' addresses

Mathematical Institute
http://www.maths.ox.ac.uk/

Statistics Department
http://www.stats.ox.ac.uk/
Computing Laboratory
http://web.comlab.ox.ac.uk/

Philosophy Centre
http://www.philosophy.ox.ac.uk/

Lecture timetables
http://www.maths.ox.ac.uk/notices/lecture-lists/

Archive of Past Exam papers 2000–2006
http://www.oxam.ox.ac.uk/

Unofficial archive of Past Exam Papers 1991–2006
http://www.maths.ox.ac.uk/teaching/past-papers/

Examiners' reports 2000-2006
http://www.maths.ox.ac.uk/notices/exam-reports/

*How do Undergraduates do Mathematics?* Notes by Charles Batty
http://www.maths.ox.ac.uk/current-students/undergraduates/study-guide/

Dr Körner's homepage
http://www.dpmms.cam.ac.uk/∼twk/

(for advice on *How to listen to a Maths Lecture*.)

## General

Comments or suggestions for matters which might be amended or which might usefully be covered in subsequent editions of this booklet would be welcome. They should be sent to the Faculty Chairman in the Mathematical Institute, or emailed to `academic.administrator@maths.ox.ac.uk`.

If you require this Handbook in a different format, please contact the Academic Administrator in the Mathematical Institute: `academic.administrator@maths.ox.ac.uk` or `(2)73530`.

# Contents

# Part I
# The Mathematics Courses

## 1 Aims and Structure

### 1.1 The Courses

The University offers two single-subject courses in Mathematics, and six joint courses:

| | | |
|---|---|---|
| **MMath** | Mathematics | 4-year |
| **BA** | Mathematics | 3-year |
| **MMathComputer Science** | Mathematics & Computer Science | 4-year |
| **BA** | Mathematics & Computer Science | 3-year |
| **MMath/Phil** | Mathematics & Philosophy | 4-year |
| **BA** | Mathematics & Philosophy | 3-year |
| **MMath** | Mathematics & Statistics | 4-year |
| **BA** | Mathematics & Statistics | 3-year |

There are also two courses:

| | | |
|---|---|---|
| **MComputer Science** | Computer Science | 4-year |
| **BA** | Computer Science | 3-year |

which share some of the first year with Mathematics & Computer Science.

This is the **Course Handbook** for the single-subject courses in Mathematics — as you progress through the course additional information and supplements will be provided. Much of what is said is also relevant to the Mathematics parts of the joint courses; see below in Appendix A.

### 1.2 Aims of the Courses

The programme aims:

- to provide, within the supportive and stimulating environment of the collegiate university, a mathematical education of excellent quality through a course which attracts students of the highest mathematical potential;

- to provide a learning environment which, by drawing on the expertise and talent of the staff, both encourages and challenges the students (recognising their different needs, interests and aspirations) to reach their full potential, personally and academically;

- to provide students with a systematic understanding of core areas and some advanced topics in mathematics, an appreciation of its wide-ranging applications, and to offer the students a range of ways to develop their skills and knowledge.

- to lay the foundations for a wide choice of careers and the successful long-term pursuit of them, particularly careers requiring numeracy, modelling and problem-solving abilities;

- to lay the foundations for employment as specialist mathematicians or in research through the study in depth of some of a broad range of topics offered;

and for students taking the 4-year MMath (Hons):

- to provide the foundations for graduate study through a research degree at a leading university either in the UK or overseas.

### 1.3 Overall Course Structure

The courses listed in 1.1 are structured so as to share certain lectures and supporting classes, and to share certain examination papers. The first-year courses, in particular, have been constructed so that it is sometimes possible to move from one course to another. Such a change needs the permission of your college, and if you think you may want to change course you should consult your College Tutor as soon as possible.

There are formal University examinations at the end of the first, second, third, and (where relevant) the fourth year of the course. (As mathematics is a progressive subject, later examinatons, by implication, cover earlier core work!)

The first year examination is called Honour Moderations, and the first year is usually referred to as 'Mods'. The second-year examination is called Part A, the third-year examination is called Part B and the fourth-year examination is called Part C.

Teaching is normally through structured lecture courses, supported by classes, and, where appropriate, practical work; and through tutorials. In the third and fourth years, there may be some reading courses involving prescribed reading and group meetings.

Assessment is normally by written examination, although there is an element of coursework in certain subjects and some of the third and fourth year options are assessed by projects or extended essays. Supplements that you will receive later will give details. Normally papers for full units are of three hours duration, except where coursework is involved.

## 2 Background

The courses are provided in the context of a large collegiate university, with about 16,250 FTE students.

### 2.1 Some Facts and Figures

The following facts about the Mathematics students may be of interest:

- offers made for October 2006 were 276; being 199 for the single subject courses, 21 for *Mathematics & Computer Science*, 28 for *Mathematics & Philosophy*;28 for *Mathematics and Statistics*
- of these 191 were men and 85 women;
- the last-examined fourth year numbered 109; being 89 in *Mathematics*, and 20 in *Mathematics & Philosophy*;
- prospective Mathematics students and their teachers can accurately forecast grades, so there is a high degree of self-selection; despite this there are almost 4 applicants per place;
- few drop out or fail, almost none later than the first year;

- for degree results please see sections 4.5 and 5.2;
- the most recent available results on first employment for mathematics students are: Study only 22%, Work only 8% and Study and work 60% (including 8% in Education, 10% in Chartered Accountancy, 13% in Investment banking, 16% in other financial services), Unemployed 6% (all figures are approximate).

## 2.2 Academic Staff

### 2.2.1 The Posts

Most established Mathematics University postholders are based in the Mathematical Institute, the Department of Statistics, or the Computing Laboratory; a few in Philosophy, Social Studies, and Physics.

The most recent research ratings (the 2001 'RAE') were: Applied Mathematics 5, Computer Science 5, Pure Mathematics 5*, Statistics 5*. A number of members of the Institute are Fellows of the Royal Society or hold EPSRC Advanced Fellowships.

In addition to those in established posts there are about 47 Postdoctoral Fellows and associates in the Departments and colleges. Other contributors to the Faculty's teaching programme include about a dozen College Lecturers. Doctoral students assist as Teaching Assistants (TAs).

In the next section we list the current Members of the Faculty of Mathematics. Details can be found on the web about members of the Computing Laboratory, Statistics Department and Philosophy Centre.

### 2.2.2 Faculty of Mathematics

Dr D J ACHESON Jesus College
Dr D ALLWRIGHT Mathematical Institute
Dr J M A ASHBOURN St Cross College
Dr R BAKER CMB, Mathematical Institute
Prof J M BALL Mathematical Institute
Prof C J K BATTY St John's College
Prof B J BIRCH Mathematical Institute
Dr C J W BREWARD Mathematical Institute
Prof P CANDELAS Mathematical Institute
Dr D C CHALLET Wadham College
Prof S J CHAPMAN Mathematical Institute
Dr M J COLLINS University College
Dr P J COLLINS St Edmund Hall
Dr E C M CROOKS Lincoln College
Dr A G CURNOCK Mathematical Institute
Dr A S DANCER Mathematical Institute
Dr W A DAY Hertford College
Dr X DE LA OSSA Mathematical Institute
Dr B R DORAN Linacre College
Prof M P F DU SAUTOY Mathematical Institute
Dr J DYSON Mansfield College
Dr R A EARL Mathematical Institute
Dr C M EDWARDS Queen's College
Dr D A EDWARDS Mathematical Institute
Dr K ERDMANN Mathematical Institute
Prof A M ETHERIDGE Magdalen College
Prof E V FLYNN New College
Dr A C FOWLER Mathematical Institute

Dr E A GAFFNEY Brasenose College
Dr K GILLOW Computing Laboratory
Dr D C GOLDREI Mansfield College
Prof N I GOULD Computing Laboratory
Dr J E GRABOWSKI Keble College
Prof I P GRANT Mathematical Institute
Dr B M HAMBLY St Anne's College
Dr K C HANNABUSS Balliol College
Dr T HAUSEL Mathematical Institute
Prof R G HAYDON Brasenose College
Prof D R HEATH-BROWN Mathematical Institute
Dr A HENKE Mathematical Institute
Prof N J HITCHIN Mathematical Institute
Dr A P HODGES Wadham College
Dr P D HOWELL University College
Dr S D HOWISON Mathematical Institute
Dr A ILHAN Mathematical Institute - OCIAM
Dr D R ISAACSON Philosophy
Prof D D JOYCE Lincoln College
Dr L KILFORD Merton College
Dr B KIRCHHEIM Mathematical Institute
Prof F C KIRWAN Balliol College
Dr R W KNIGHT Worcester College
Dr J KRISTENSEN Magdalen College
Prof M LACKENBY St Catherine's College
Dr A G B LAUDER Hertford College
Dr R A LEESE St Catherine's College
Dr J C LENNOX Green College
Dr R J LINGWOOD Continuing Professional Development
Dr J LOTAY University College
Dr G L LUKE Mathematical Institute
Prof T J LYONS Mathematical Institute
Prof P K MAINI Mathematical Institute
Mr S P MARSHALL Wadham College
Prof L J MASON St Peter's College
Prof C J H MCDIARMID Corpus Christi College
Dr M MONOYIOS Lady Margaret Hall
Dr I M MOROZ Mathematical Institute
Dr G NELSON St Anne's College
Dr P M NEUMANN Queen's College
Dr J NORBURY Lincoln College
Dr H OCKENDON Mathematical Institute
Dr J R OCKENDON Mathematical Institute
Prof Sir R PENROSE Mathematical Institute
Prof H A PRIESTLEY Mathematical Institute
Dr C R PRIOR Trinity College
Dr Z QIAN Exeter College
Prof D G QUILLEN Magdalen College
Dr C REISINGER Mathematical Institute - OCIAM
Dr D J ROAF Exeter College
Dr G SCATAGLINI-BELGHITAR Balliol College
Prof A D SCOTT Merton College
Dr G R SCREATON University College
Prof D SEGAL All Souls College

Dr G B SEGAL All Souls College
Dr L A SMITH Pembroke College
Dr J A STEDALL Queen's College
Dr W B STEWART Exeter College
Dr D STIRZAKER St John's College
Dr G A STOY Lady Margaret Hall
Dr B SZENDROI St Peter's College
Dr P M TARRES St Hugh's College
Prof U L TILLMANN Mathematical Institute
Dr M TINDALL Mathematical Biology Group, Mathematical Institute
Prof K P TOD St John's College
Dr S T TSOU Mathematical Institute
Prof M R VAUGHAN-LEE Christ Church
Dr G F VINCENT-SMITH Oriel College
Dr A WATSON Department of Educational Studies
Prof D J A WELSH Mathematical Institute
Prof A J WILKIE Mathematical Institute
Dr C A WILKINS
Prof J S WILSON University College
Prof R J WILSON Keble College
Prof N M J WOODHOUSE Mathematical Institute
Prof B ZILBER Mathematical Institute

## 2.3 The Departments

### 2.3.1 The Mathematical Institute

The Mathematical Institute is a focus for mathematical activity in Oxford. The members of the Mathematical Institute include more than 120 graduate students as well as professors, readers, other members of staff and academic visitors. There are at least 5 statutory chairs in Pure Mathematics and at least 4 statutory chairs in Applied Mathematics. Many other academics hold the title of professor. The Mathematical Institute, as the mathematics department is known, incorporates the Oxford Centre for Industrial and Applied Mathematics, as well as the Centre for Mathematical Biology. Whilst it is usual for mathematics departments in Britain to be split into departments of Pure and Applied Mathematics, the unitary Oxford structure, which encourages numerous strong interactions between the different groups, is regarded as a major factor in the continued high reputation enjoyed by Oxford Mathematics.

Research is carried out in a wide variety of fields including algebraic, differential and general topology, group theory, representation theory and other branches of algebra, number theory, mathematical logic, functional analysis, harmonic analysis, algebraic and differential geometry, differential equations, probability theory and its applications, combinatorial theory, global analysis, mathematical modelling, financial mathematics, stochastic analysis, mathematical biology, ecology and epidemiology, continuum mechanics, elasticity, applied and fluid mechanics, magnetohydrodynamics and plasmas, atomic and molecular structure, quantum theory and field theory, relativity and mathematical physics, applied analysis and materials science.

You may find out more about the Institute by visiting the website:

http://www.maths.ox.ac.uk/.

### 2.3.2 The Department of Statistics

The Department of Statistics provides a focus for Statistics within the University, and has numerous links with outside scientific and industrial concerns.

You may find out more about the Department by visiting the website: http://www.stats.ox.ac.uk/.

### 2.3.3 The Computing Laboratory

Oxford University Computing Laboratory is one of the world's leading centres for the study, development and exploitation of computing technology.

You may find out more about the Laboratory by visiting the website: http://www.comlab.ox.ac.uk/.

# 3 The First Year

The first year course is run as a joint venture with the Statistics Department.

In the first year there are no optional topics. The **Syllabus** is given in Part V-1 of this Handbook and is covered in lectures whose content has been carefully planned. This is teh official syllabus for the Honour Moderations Examinations for 2007. They form a coordinated programme which avoids unnecessary duplication but ensures full and careful coverage, and which will allow you to prepare for the examinations. The **Lecture Synopses** are in Part V-1 of this **Handbook**. **Reading Lists** are given alongside the synopses.

## 3.1 The Lecture Courses

The lecture courses in the first year are as follows:

**Michaelmas Term**

| | |
|---|---|
| Introductory Mathematics | 5 lectures |
| Linear Algebra | 14 lectures |
| Geometry I | 7 lectures |
| Analysis I | 14 lectures |
| Calculus of One Variable | 6 lectures |
| Dynamics | 16 lectures |
| Probability | 8 lectures |
| Calculus of Two or more Variables | 10 lectures |

**Hilary Term**

| | |
|---|---|
| Linear Algebra | 8 lectures |
| Some Theory of Sets and Groups I | 8 lectures |
| Analysis II | 16 lectures |
| Probability | 8 lectures |
| Statistics | 8 lectures |
| Fourier Series and Two Variable Calculus | 16 lectures |
| Partial Differential Equations in Two Variables and Applications | 16 lectures |

**Trinity Term**

| | |
|---|---|
| Some Theory of Sets and Groups II | 8 lectures |
| Geometry II | 8 lectures |
| Analysis III | 8 lectures |
| Calculus in Three Dimensions and Applications | 16 lectures |

## 3.2 The Maple Course

The Maple Course

In addition to the written papers for Moderations, students reading Mathematics or Mathematics & Statistics are required to follow a compulsory computing course "Exploring Mathematics with Maple". This course has been devised to acquaint mathematicians with the use of computers as an aid to learning about mathematics, and to give access to a useful mathematics package software tool.

The course is computer-based and so you must be a registered user of the Mathematical Institute network. You will be allocated an account before the course begins. Practicals are done in the teaching laboratory in G17 in the Mathematical Institute. Undergraduates may also use college computers where these are available; with appropriate software supplied by colleges it is possible to log-on to your Institute account, and run Maple from a college machine. Undergraduates may also obtain a free license to run Maple on their own computers.

The course is divided into two parts, one part in each of Michaelmas and Hilary Terms. The Michaelmas Term work consists of preparatory work. Four practicals of two hours each are timetabled. There are people available to help.

In Hilary Term you work on two Maple projects. These must be your own unaided work; you will be asked to make a declaration to that effect when you submit them. The marks are communicated to the Moderators, who will take them into account.

It is important to observe the deadlines for handling in Maple projects. Failure to meet the deadlines may mean that the work will not be taken into account. For 2007 the deadlines are:

- **1st project: 12.00 noon on Friday of week 5**
- **2nd project: 12.00 noon on Friday of week 8**

  The work for these projects must be your own work.

  Students transferring into Mathematics from any other subject will still be expected to submit two Maple projects (or to suffer the lack of marks as a consequence).

## 3.3 The Examinations

The three- and four-year courses have the same University examination, Honour Moderations in Mathematics, at the end of the third term of the first year. There are no lectures in the second half of this term to give you extra time to prepare for the examination. The examination consists of four papers, each of three hours duration: Pure Mathematics I, Pure Mathematics II, Applied Mathematics I, Applied Mathematics II. Each paper has eight questions, and you will be instructed to submit answers to no more than five questions. No books or tables may be taken into the examination room. Calculators are not normally permitted, you should follow instructions in notices sent to you by the Chairman of Examiners regarding calculators. The Moderators (Examiners in Moderations) will also take into account the marks awarded for your work on the Maple projects. The Moderators give **Advice to Candidates** on their Marking Conventions and how they identify and reward excellence; see Appendix B for more information.

### 3.3.1 Examination Results

On the strength of your performance in Mods, you will be classified (in the First, Second or Third Class) or given a Pass or failed. The percentages in each category for recent years were:

| | First | Second | Third | Pass | Fail |
|---|---|---|---|---|---|
| 2001 | 30.0% | 58.9% | 6.3% | 2.1% | 2.6% |
| 2002 | 29.0% | 58.5% | 8.7% | 0.0% | 3.8% |
| 2003 | 30.1% | 59.6% | 6.2% | 1% | 3.1% |
| 2004 | 29.5% | 51.5% | 9.0% | 7.0% | 3.0% |
| 2005 | 30% | 53% | 12% | 3% | 2% |
| 2006 | 37% | 45% | 11% | 3% | 4% |

The Examiners will provide you, through your college, with University Standardised Marks for each paper. These describe, paper by paper your performance on the examination and are the marks which will appear on your transcript. See Appendix B for further information on how the examiners determine the class from these paper marks.

#### 3.3.2 Re-sits

Those who fail Mods or were unable to sit the examination because of illness or other urgent and reasonable cause may, at the discretion of their college, enter for the Preliminary Examination in Mathematics. The Preliminary examination is an unclassified examination which candidates either pass or fail and consists of two papers taken in the following September.

### 3.4 Changing Course

Normally your college will have admitted you to study a specific course. Permission will therefore be needed for change to another course, including changes between the single-subject and joint Mathematics courses. These courses are, however, structured so as to make some changes feasible, particularly during the first year. Again, your College Tutors will be able to give you advice, and you may find it helpful to talk to students reading the course. If you are given permission to change course, then you will have to catch up on the work missed.

## 4 Three or Four Years

When you applied you will have been advised to assume that you are taking the four year course, and to inform your LEA accordingly. This precaution should be taken for funding reasons. At the beginning of your third year you should decide, taking into account the advice of your college tutors, whether you should choose the three- or four-year course. You will be asked to register this choice.

In making your choice you will have to consider the information about the two courses in this **Handbook**, and also your preferred career. You may also like to get the views of those in your college on their experience of the courses. The options for the fourth year of the **MMath** course contain more advanced material and your performance in tutorials and classes and on examinations in earlier years will need to be taken into consideration.

### 4.1 Three- or Four-year course

You should register your intention to take either the three-year course or the four-year course early in your third year. You are advised to discuss the right course of action for you with your College Tutor, who will also advise you how to register. Any student whose performance in the second and third year examination together falls below Honour standard will not be permitted to proceed to the fourth year.

## 5 The Second, Third and Fourth Years

In the second, third and fourth year of your course many options are available. These vary a little from year to year. The list below shows the options available in the academic year 2006-7. You will recieve information on the options, year by year, when it becomes available.

## 5.1 The Second Year (Part A)

The second year course will consist of three compulsory subjects (core material);

- Algebra
- Analysis
- Differential Equations

followed by a number of options:

- Groups in Action
- Introduction to Fields
- Number Theory
- Integration
- Topology
- Multivariable Calculus
- Calculus of Variations
- Classical Mechanics
- Electromagnetism
- Fluid Dynamics and Waves
- Probability
- Statistics
- Numerical Analysis

The compulsory core is studied in Michaelmas Term. The options are studied in Hilary, and the first half of Trinity Term.
The Mathematical Institute is responsible for the delivery of all units except for those on Probability & Statistics, which are the responsibility of the Department of Statistics, and those in Numerical Analysis, which are the responsibility of the Computing Laboratory.

## 5.2 The Third and Fourth years (Parts B and C)

A student will take the equivalent of four 32-hour units in the third year of either H or M level; those continuing to the fourth year will be expected to take the equivalent of three M level 32-hour units in that year.

The units and half units will be designated H-level (aimed at the third year undergraduates) or M-level (aimed primarily at the fourth year or M.Sc. students).

## 5.3 Pathways

Formal details of which combinations of units you may offer in the examinations will be published by the University in the **Examination Regulations**. The **Lecture Synopses** will describe recommended 'background courses'. It should be noted that you may choose a course even though you have not done the background courses, but the lecturers and examiners will lecture and examine on the hypothesis that you have the background. If you wish to take a course and you have not taken the recommended background courses then you are advised to consult your college tutors who may be able to help and advise you on alternative background reading.

## 5.4 Making Choices

Your College Tutors will be able to give you advice. Some preliminary work in the libraries, looking at the books recommended in the **Reading Lists** may also help. **Past Papers**, and **Examiners' Reports** may give some of the flavour. When making your choice you should consider not only options which you find interesting and attractive, but also the terms in which lectures and classes are held. Ideally, your work in Michaelmas and Hilary terms should be spread evenly.

### 5.4.1 Part B Units and Half Units

**MATHEMATICS DEPARTMENT UNITS AND HALF UNITS**

- B1 Logic and Set Theory
  - B1a Logic — MT (half unit)
  - B1b Set Theory — HT (half unit)
- B2 Algebra — MT & HT (whole unit)
- B3 Geometry
  - B3a Geometry of Surfaces — MT (half unit)
  - B3b Algebraic Curves — HT (half unit)
- B4 Analysis
  - B4a Analysis I — MT (half unit)
  - B4b Analysis II — HT (half unit, cannot be taken unless B4a is taken)
- B568 Introduction to Applied Mathematics
- B5 Applied Analysis
  - B5a Techniques of Applied Mathematics — MT (half unit)
  - B5b Applied Partial Differential Equations — HT (half unit)
- B6 Theoretical Mechanics
  - B6a Viscous Flow — MT (half unit)
  - B6b Waves and Compressible Flow — HT (half unit)
- B7.1/C7.1 Quantum Mechanics, Quantum Theory and Quantum Computers
  - B7.1a Quantum Mechanics — MT (half unit)
  - C7.1b Quantum Theory and Quantum Computers — HT (half unit, cannot be taken unless B7.1a is taken)
- B7.2/C7.2 Relativity
  - B7.2a Special Relativity and Electromagnetism — MT (half unit)
  - C7.1b General Relativity — HT (half unit, cannot be taken unless B7.2a is taken)
- B8 Topics in Applied Mathematics
  - B8a Mathematical Ecology and Biology — MT (half unit)

- B8b Nonlinear Systems — HT (half unit)

- B9 Number Theory
  - B9a Polynomial Rings and Galois Theory — MT (half unit)
  - B9b Algebraic Number Theory — HT (half unit, cannot be taken unless B9a is taken)
- B10 Martingales and Financial Mathematics
  - B10a Martingales Through Measure Theory — MT (half unit)
  - B10b Mathematical Models of Financial Derivatives — HT (half unit)
- B11 Communication Theory — MT (half unit)
- B21 Numerical Solutions to Differential Equations
  - B21a Numerical Solution of Differential Equations I — MT (half unit)
  - B21b Numerical Solutions of Differential Equations II - HT (half unit)
- B22 Integer Programming — MT (half-unit)
- C3.1 - Geometry: Topology and Groups and Algebraic Topology
  - C3.1a Topology and Groups — MT (half unit: M-level)
  - C3.1b Algebraic Topology — HT (half unit: M-level)
- C5.1a Partial Differential Equations for Pure and Applied Mathematicians — MT (half unit: M-level)
- C9.1a Analytic Number Theory — MT (half unit: M-level)
- BE "Mathematical" Extended Essay (whole unit)

**OTHER MATHEMATICAL UNITS AND HALF UNITS**

- O1 History of Mathematics — MT & HT (whole unit)
- OBS1 Applied Statistics — MT & HT (whole unit)
- OBS2 Statistical Inference — HT (half unit)
- OBS3 Stochastic Modelling
  - OBS3a Applied Probability — MT (half unit)
  - OBS3b Statistical Lifetime Models — HT (half unit, cannot be taken unless OBSa is taken)
- OBS4 Actuarial Science — MT & HT (whole unit)
- OCS1 Functional Programming and Data Structures and Algorithms — MT & HT (whole unit)
- OCS2a Logic of Multi-Agent Information Flow — MT (half unit)
- OCS3a Lambda Calculus and Types — MT (half unit)
- OE Extended Essay in a topic closely related to Mathematics (whole unit)

**OTHER NON-MATHEMATICAL UNITS AND HALF-UNITS**

- N1 Undergraduate Ambassadors' Scheme — (MT, HT) (half-unit)
- N101 History of Philosophy from Descartes to Kant (whole unit)
- N102 Knowledge and Reality (whole unit)
- N122 Philosophy of Mathematics (whole unit)

### 5.4.2 Part C Units and Half Units

**MATHEMATICS DEPARTMENT UNITS AND HALF-UNITS:**

- C1.1 Model Theory and Godel's Incompleteness Theorems
  - C1.1a Gödel's Incompleteness Theorems — MT (half unit)
  - C1.1b Model Theory — HT (half unit)
- C1.2 Axiomatic Set Theory and Analytic Topology
  - C1.2a Axiomatic Set Theory — MT (half unit)
  - C1.2b Analytic Topology — HT (half unit)
- C2.1 Lie Algebars and Representation Theory of Symmetric Groups
  - C2.1a Lie Algebras — MT (half unit)
  - C2.1b Representation Theory of Symmetric Groups — HT (half unit)
- C3.1 Topology and Groups and Algebraic Topology
  - C3.1a Topology and Groups — MT (half unit)
  - C3.1b Algebraic Topology — HT (half unit)
- C4.1 Functional Analysis and Banach and C* Algebras
  - C4.1a Functional Analysis — MT (half unit)
  - C4.1b Banach and C* Algebras — HT (half unit)
- C4.2a Real and Harmonic Analysis — MT (half unit)
- C5.1 Partial Differential Equations for Pure and Applied Mathematicians and Calculus of Variations
  - C5.1a Partial Differential Equations for Pure and Applied Mathematicians — MT (half unit)
  - C5.1b Calculus of Variations — HT (half unit, cannot be taken unless C5.1a is taken)
- C6.1 Solid Mechanics — MT (half unit)
- C6.2 Elasticity and Plasticity — HT (half unit)
- C6.3 Perturbation Methods and Applied Complex Variables
  - C6.3a Perturbation Methods — MT (half unit)
  - C6.3b Applied Complex Variables — HT (half unit)
- C7 Mathematical Physics

- C7.1a Quantum Theory and Quantum Computers — MT (half unit)
- C7.1b General Relativity — HT (half unit)

- C7.2 Further Quantum Theory and Quantum Field Theory
  - C7.2a Further Quantum Theory — MT (half unit)
  - C7.2b Quantum Field Theory — HT (half unit)
- C7.3 Advanced Quantum Mechanics — MT & HT (whole unit)
- C8.1 Mathematics and the Environment and Mathematical Physiology
  - C8.1a Mathematics and the Environment — MT (half unit)
  - C8.1b Mathematical Physiology — HT (half unit)
- C9.1 Analytic Number Theory and Elliptic Curves
  - C9.1a Analytic Number Theory — MT (half unit)
  - C9.1b Elliptic Curves — HT (half unit)

  C10.1 Stochastic Differential Equations and Brownian Motion in Complex Analysis
  - C10.1a Stochastic Differential Equations — MT (half unit)
  - C10.1b Brownian Motion in Complex Analysis — HT (half unit)
- C11.1 Graph Theory and Probabilistic Combinatorics
  - C11.1a Graph Theory — MT (half unit)
  - C11.1b Probabilistic Combinatorics — HT (half unit, cannot be taken unless C11.1a is taken)
- C12.1 Numerical Linear Algebra and Continuous Optimisation
  - C12.1a Numerical Linear Algebra — MT (half unit)
  - C12.1b Continuos Optimisation — HT (half unit)
- C12.2 Approximation Theory and Finite Element Methods
  - C12.2a Approximation Theory — MT (half unit)
  - C12.2b Finite Element Methods — HT (half unit)
- Dissertations — half unit or whole unit

**OTHER UNITS**

MS STATISTICS

- MS1a Graphical Models and Inference — MT (half unit)
- MS1b Statistical Data Mining — HT (half unit)
- MS2a Bioinformatics and Computational Biology — MT (half unit)
- MS2b Stochastic Models in Mathematical Genetics — HT (half unit)

COMPUTER SCIENCE: Half Units

- Computer Science: CCS1 Categories, Proofs and Programs — MT (half unit)
- Computer Science: CCS2 Domain Theory — HT (half unit)
- Computer Science: CCS5 Quantum Computer Science — HT (half unit)

PHILOSOPHY

- Rise of Modern Logic — MT (whole unit)

## 5.5 The Examinations

### 5.5.1 The BA in Mathematics

If you take the three-year BA course, you will take Part A of the University examination at the end of your second year and Part B at the end of your third year. The formal details of which combination of papers you may offer in the examination will be published by the University in the **Examination Regulations**. In total you must take the equivalent of eight papers. The Examiners give **Advice to Candidates** on their Marking conventions etc.

On the basis of your performance in the examination you will be classified (First, Upper Second, Lower Second, Third Class) or given a Pass or failed. Recent statistics for the BA degree are:

| | First | Upper Second | Lower Second | Third | Pass | Fail |
|---|---|---|---|---|---|---|
| 2001 | 19.8% | 56.9% | 12.1% | 6.9% | 4.3% | 0% |
| 2002 | 20.5% | 53.8% | 14.5% | 10.3% | 0% | 0.9% |
| 2003 | 22.8% | 50.4% | 21.3% | 1.6% | 3.1% | 0.8% |
| 2004 | 25.7% | 48.5% | 17.8% | 5.0% | 1.0% | 2.0% |
| 2005 | 27.1% | 50.0% | 17.1% | 5.7% | 0% | 0% |

Please refer to `https://www.maths.ox.ac.uk/notices/exam-reports/` for the most up-to date statistics.

### 5.5.2 The MMath in Mathematics

If you take the MMath course, the second and third year will be very similar to the BA and you will also take Part C at the end of fourth year .

The **Examination Regulations** and amendments published in the University Gazette will give full details.

Those taking Part C (MMath) from 2008 onwards will receive a class at the end of Part B (as above) and a separate class for Part C. [Prior to 2008 students have received a single class at the end of four years. Recent statistics for the MMath degree are:

| | First | Upper Second | Lower Second | Third | Pass | Fail |
|---|---|---|---|---|---|---|
| 2001 | 53.7% | 27.8% | 14.8% | 1.9% | 1.9% | 0% |
| 2002 | 47.6% | 38.1% | 14.3% | 0% | 0% | 0% |
| 2003 | 50.0% | 35.1% | 9.5% | 5.4% | 0% | 0% |
| 2004 | 54.4% | 29.4% | 11.8% | 2.9% | 1.5% | 0% |
| 2005 | 44.7% | 47.4% | 5.3% | 2.6% | 0% | 0% |
| 2006 | 58.43% | 34.83% | 6.73% | 0% | 0% | 0% |

Please refer to `https://www.maths.ox.ac.uk/notices/exam-reports/` for the most up-to date statistics.

### 5.5.3 Examination Results

The Examiners will provide you, through your college, with a letter setting out your performance on each paper in University Standardised Marks.

### 5.5.4 Repeats and Re-sits

For details of the regulations concerning repeats see the relevant sections of the **Examination Regulations**. Your College Tutor will also be able to give advice about these very infrequently used procedures.

# 6 Projects, Dissertations, Extended Essays

Third year students may write an extended essay, equivalent to one unit or 32 lectures.

Fourth-year students may write a half-unit or a full-unit dissertation.

Projects give students the opportunity to develop valuable skills - collecting material, explaining it, expanding it clearly and persuasively. Some students show their absolute abilities better on a sustained piece of exposition rather than on solving problems set in a three-hour examination paper.

# Part II
# Learning and Teaching

## 1 Lectures

All official lectures are advertised in the termly **Lecture List** for Mathematical Sciences. Copies of the lecture list are distributed at the beginning of each term by College Tutors. The Lecture List is also posted on the Mathematical University website at
http://www.maths.ox.ac.uk/notices/lecture-lists/,
and on the University website at
http://www.admin.ox.ac.uk/pubs/lectures/.
In addition, the term's lecture list and each week's timetable with details of lecture rooms are posted on the notice board in the Mathematical Institute.

Lectures are usually timetabled to last an hour. So that you have time to get to lectures in different locations, there is a convention that undergraduate lectures begin a few minutes after the scheduled time and finish five minutes before the end of the hour.

Most students find it helpful to take fairly complete notes of lectures. The normal lecturing style in the Faculty is intended to make this possible, and all the main points should be presented visually as well as orally.

If you have a disability or special needs, which affect your ability to take notes of lectures, please contact the Disability Services, your college tutor and the Academic Administrator in the Mathematical Institute (contact details in Appendix C). Please also see the Departmental Disability Statement at Appendix G.

## 2 Problem Sheets

All lectures in Mathematics are supported by **Problem Sheets** compiled by the lecturers. These available for downloading from the Mathematical Institute website. Most students prefer to print their own copies, although they can be printed by the department by prior arrangement. Many College Tutors use these problems for their tutorials; others prefer to make up their own problem sheets. In Part B and Part C, problem sheets will be used for the classes run in conjunction with the lectures.

Many of the books recommended in the **Reading Lists** contain exercises and worked examples; **Past Papers** and **Specimen Papers** are another source of such material, especially for revision.

## 3 Tutorials

In addition to lectures, students also have tutorials. How these are organised will vary from college to college and subject to subject. For example you might have two (one-hour) tutorials each week, with between one and three other students. You will be set some work to do for each tutorial and in the tutorial you will discuss this work and will probably have an opportunity to ask about any difficulties you may experience. In order to get the best out of a tutorial it is very important that you are well prepared. You should have done the work and handed it in if this is expected (even if you have not been able to solve every problem). It is also a good idea to make a note of anything you want to ask about. Be sure to arrive on time.

# 4 Classes

Each 16-hour lecture half unit in the subjects of Part B will be supported by classes run under the Intercollegiate Class Mathematics Scheme. Most Part C half units will be supported by classes, though some may be run as reading courses.

Classes will usually consist of between five and twelve students from a number of different colleges and are run by a Class Tutor and a Teaching Assistant. Occasionally, for instance as an alternative to restricting student numbers taking an option, classes will be run in larger groups; but students and their tutors will be advised well in advance if this is to be the case. The Course Lecturer provides suitable **Problem Sheets**, and provides specimen solutions to the Class Tutors and Teaching Assistants. Students hand in their solutions in advance and these are marked by the Teaching Assistants; at each class, some of the problems will be gone through in detail, and there will be an opportunity to take up with the Class Tutor and Teaching Assistant any particular difficulties. The Class Tutors report to colleges through the intercollegiate class database on your performance throughout the term.

You will receive information about the organisation of these classes from your College Tutor.

Most colleges also run classes, especially to help with pre-examination revision. College Tutors will explain their own arrangements.

# 5 Practicals

For some of the units there is a component of compulsory practical work. The arrangements for this will be explained by the Course Lecturer; your College Tutor will also advise. Those who run the practical sessions will also give advice on how the work is to be written-up.

# 6 Feedback

There is plenty of opportunity, both formal and informal, for you to comment on the course. The informal ways are through the members of the Faculty who teach you in classes, lectures and tutorials and also through your personal tutors in college. All of these members of the Faculty will encourage you to make your views known to them and will give you ample opportunity to comment on syllabus content and any other issues about the delivery of the course.

A written questionnaire is handed out by each lecturer, who gives time in the lecture for students to complete it. A similar monitoring of the Intercollegiate Classes takes place termly.

Once the termly questionnaire results are processed, each Course Lecturer receives the comments and statistical analysis from their own course and in addition consolidated information is made available to relevant committees for discussion, and where necessary, action. One of the key committees which considers this information is the *Joint Consultative Committee with Undergraduates* and the action taken as a result of questionnaire comments is made known to your representatives through this channel. This Committee deals with matters over the whole range of Mathematics, Computer Science and Statistics courses.

We welcome your input and feel that you have an important contribution to make. Please use this opportunity and take the time to fill in the questionnaires at the end of lecture courses. A specimen questionnaire form is given in Appendix D. **Questionnaires can also be downloaded from the web.**

# 7 Responsibility

This whole section has described the *Teaching* arrangements for the course. But of course the important thing is *Learning*. The University and the Colleges will provide facilities and resources to assist your learning. The Course Lecturers, Class Tutors, and College Tutors will do all they can to help and encourage you to learn. But the responsibility for learning is a personal one.

# 8 History of Mathematics

You are encouraged to read around your subject, particularly to read some of the history of its development. We include here a short list of books that have been recommended by tutors for you to dip into at various times during your time at Oxford.

J Fauvel & J Gray, *The History of Mathematics, a reader* Macmillan (1987)
J Fauvel, R Flood & R Wilson, *Oxford figures: 800 years of the mathematical sciences*, OUP (2000)
M Kline, *Mathematics in Western Culture*, Penguin (1972)
V Katz, *A History of Mathematics: An Introduction* Second Edition, Addison-Wesley (1998)
D Struik, *A Concise History of Mathematics*, Dover Paperback, 1946
M Kline, *Mathematical Thought from Ancient to Modern Times*, OUP 1972
Heinrich Dörrie, *100 Great Problems of Elementary Mathematics*, Dover 1965
Ioan James, *Remarkable Mathematicians, from Euler to von Neumann* CUP 2002

# Part III
# Resources

## 1 Books

Do not think that a complete set of lecture notes for a course removes the need to consult textbooks. You will need constant access to books in the course of your studies, for clarifying points made in lectures, completing arguments given partially, doing things in different ways, helping with problems and so on. The **Reading Lists** issued alongside the **Lecture Synopses** are revised annually, and contain a range of suggestions, including alternatives and suggestions for further reading.

To make best use of a book, you need your own copy so think seriously of buying at least the books with the highest recommendations—your College Tutor will be able to advise you on which to buy. Often you will be able to buy such books from your predecessors in your college, or through the virtual second-hand Bookstall run by MURC. Second-hand copies are also available in Blackwells secondhand department but they sell out rapidly. Amazon also sells second hand books.

## 2 Libraries

The main source of borrowed books is your **College Library** which you should get to know as soon as possible. It is general practice for College Libraries to purchase the books which appear in the **Reading Lists** for every Mods, Part A and Part B course. In practice College Libraries also provide a good selection of the books listed as 'Further Reading' for these courses, and indeed a wider selection of background and alternative reading, particularly books which have not been recommended because they have gone out of print.

College Libraries frequently have a number of copies of popular books and are often responsive to requests for new purchases, but *they do need to be asked.* Different colleges have different mechanisms for these requests; again your College Tutor will be able to advise you.

The other source of books to borrow is the **Hooke Library** in South Parks Road, open during the ten weeks around full term. This is an undergraduate borrowing library associated with the **Bodleian** and you need to be registered with the **Bodleian** to use it. When you arrive in Oxford you will be required to sign a declaration promising to obey the Library rules and you will then be given a combined reader's card/University card. This will give you access to any part of the **Bodleian Library** and any of its dependent libraries, including the **Radcliffe Science Library** in Parks Road. This is for reference only, and it is possible to work there comfortably.

## 3 IT

The University is committed to making sufficient computer facilities available to junior members to cover their course-work requirements. In the Mathematical Institute computers for undergraduate course-work are housed in room G17.

Mathematics students will be allocated a mathematics computing account which can be used for coursework and for other more general purposes such as e-mail.

All students will also be automatically allocated a University e-mail account and may register for further services at Oxford University Computing Services. (See 4.1

below). A number of important notices will be sent to you via email. It is important to check your account frequently.

Colleges have PCs (and in some cases Macs), mostly networked, for the use of junior members. Many colleges have students' rooms wired with ethernet points to enable students to connect their own PCs to the network.

As everywhere, there is concern for computer security and anyone opening an account must agree to abide by the local rules. At Oxford there is a University disciplinary procedure enforcing the rules, so that breaches of them involve the Proctors with all the sanctions and penalties available to them.

**Note that some webpages (e.g. the webpage with class details) are NOT available from outside the Oxford network. If you are regularly using a computer outside the Oxford network, you need to set up VPN. Instructions on how to do this can be found at http://www.maths.ox.ac.uk/help/faqs/login/vpn/vpnxp.shtml.**

# 4 Other

## 4.1 Computing Services

Your computing requirements will be supported primarily by the Departmental and College Computing and IT staff; certain facilities of the central Computing Services are available when appropriate.

*Oxford University Computing Services* are located at 13 Banbury Road and offer facilities, training and advice to members of the University in all aspects of academic computing. The central services are based on a number of main computer systems together with core networks reaching all departments and colleges. You can find more information at

http://www.oucs.ox.ac.uk/

## 4.2 The Language Centre

The *Language Centre* provides resources and services for members of the University who need foreign languages for their study, research or personal interest.

Language courses in eight languages, the Language Library (consisting of over 13,000 audio and video cassettes with accompanying textbooks in over 100 languages) and its Study Area (computer-based learning resources and audio/video study rooms) are available free of charge to Junior Members of the University pursuing a course. Those in possession of a University Card must present it when they register at the Centre. Prospective users without a University Card must present a letter from their College or Departmental Administrator indicating their status within the University. You can find more information at

http://www.units.ox.ac.uk/departments/langcentre/

There may be an opportunity for students who have studied some French (particularly those who have studied to GCSE level but not to A-level) to take a course in the third or fourth year. This will not count towards your degree class but may be recorded on your transcript or CV.

## 4.3 Careers

Careers guidance is provided by the *Careers Service*, and at a personal level by College Tutors. Careers advisers carry out guidance interviews with students, discussing with them their skills and aspirations. Training is also given in applications and interview techniques and analysis of transferable skills, in addition to providing

many opportunities for students to research occupations and employers and gain work experience.

Members of the Faculty who have taught you are usually willing to provide support and references. The Service provides a link-person, who has expertise in areas where mathematicians are often in demand, for example, in finance careers. College Tutors are regularly updated on Careers Service activities.

In addition to its general programme, the Service runs an annual 'Jobs for Mathematicians' half-day, in collaboration with the Mathematical Institute. This event has alumni-speakers representative of jobs particularly suitable for mathematicians and also helps students consider their transferable skills. Members of academic staff contribute to the success of these sessions. You can find more information at

http://www.careers.ox.ac.uk

The Mathematics Undergraduate Representation Committee (MURC) has also set up an emailing list for careers and studentship information. If you wish to receive such information you should sign up. You can do this by sending a blank message to `murc-jobs-join@maths.ox.ac.uk`. The system will confirm your request and once that is completed you will be registered to receive careers information.

## 4.4 University Lectures

University lectures in all subjects (although not *classes*) are open to all students. A consolidated **Lecture List** is available on the University website at: http://www.maths.ox.ac.uk/notices/lecture-lists/. Further information can be found at http://www.admin.ox.ac.uk/pubs/lectures/

The seminars and colloquia given in the Mathematical Institute, often by mathematicians of international repute, are announced on the departmental notice boards; although usually aimed at faculty and research students, all interested in the subject are welcome to attend.

## 4.5 Study Skills

Much of the advice and training in Study Skills will come in the regular tutorial and class teaching your college arranges for you. In these sessions, and in preparation for them, you will develop your powers of expression and argument. There is also good advice in Batty's "How do Undergraduates do Mathematics?" available in paper copy from reception in the Mathematical Institute, and electronically on the website. The *Projects Committee* gives guidance on the choice and preparation of extended essays and dissertations.

## 4.6 Special Needs

Specialised advice and assistance is available for dyslexic, blind/partially sighted, and other disabled students from the University Disability Office (www.admin.ox.ac.uk/eop or disability@admin.ox.ac.uk or 01865 (2)80459.)

If you experience difficulties with your course because of a disability then you should discuss this with your college tutors. Some colleges have a specific member of staff who assists students with welfare difficulties. Please also see the Mathematical Institute Departmental Disability Statement, appended at G.

# Part IV
# Organisation and Representation

## 1 Mathematical, Physical & Life Sciences Division

The Mathematics courses are overseen by the Mathematical, Physical & Life Sciences Division. The responsibility for the delivery of the courses has been placed on various Departments in the Division.

## 2 The Departments

Members teaching undergraduate mathematics tend to belong to one of three departments: the Mathematical Institute, the Department of Statistics, and the Computing Laboratory. These departments provide most of the facilities for the courses. In Section 2.3 of Part I, there is a description of the general activities of the departments.

The Mathematical Institute acts as the focus of activity in Mathematics. It houses the Whitehead Library (for research in Mathematics - not an undergraduate library).

The Institute contains lecture theatres and seminar rooms in which undergraduate lectures and classes are given after the first year. (First-year lectures are delivered in the University Museum Lecture Theatre.) The Maple course demonstration sessions are held in the computing workshop (G17) at the Institute. Lecture notes are sold at the Reception desk, problem sheets may be downloaded from the mathematics website. Most matters concerned with the administration of the mathematics courses are dealt with in the Institute—for example the production of synopses, lecture timetables and lecture notes. If you have any comments relating to Departmental Provision, please contact the Academic Administrator in the first instance (contact details in Appendix C.)

## 3 The Faculties

The University staff in each department, and main College teachers in the subject areas, are grouped together in a Faculty. The Faculties provide a broad consultative framework which ensures that the views of all teaching staff are taken into account when decisions about admissions, syllabus, teaching and examining are made.

## 4 Colleges

The relationship between University and Colleges is a complicated one. As you already know, Colleges make their own decisions on admissions, and the academic and personal well-being of undergraduates is largely the concern of the Colleges. Courses, syllabuses and lectures are planned and put on by the University, and examinations are set and marked by the University. Tutorial teaching is done by the Colleges, and there are increasing numbers of inter-collegiate classes.

In your College there will be one or more subject tutors who will jointly guide your studies. This will involve arranging tutorials, usually done in meetings at the beginning of term, and discussing and advising on choice of options. In the first instance, any work-related questions can be taken to one of these tutors. You may hope to find, as many people do, that your relationship with one or other of

your subject tutors is good enough that you can take most other, non-work-related, questions to them also. However, for the times when this isn't the case, many Colleges have a separate system of student advisers or personal tutors. You will need to see how things are organised in your own College.

Colleges also differ between themselves in other additional provisions: some have book grant or book loan schemes to assist you to acquire books; some have good provision of junior members' computing facilities; in some, time is devoted to "study-skill sessions" which aim to assist new students in making the adjustment to the academic demands of university life. Again, you will need to see how it works in your College.

# 5 Representation

## 5.1 MURC

The Mathematics Undergraduate Representative Committee (informally known as MURC) is a student body representing the interests of mathematics, computer science and statistics students. It consists of a representative from each college, elected by undergraduates in these subjects of the college. It holds regular meetings to discuss issues connected with academic organisation of the course such as lectures, examinations and syllabus content. It is the forum which allows undergraduates, through their representatives to raise issues connected with their course, and it is important for colleges to elect a representative to the committee.

The views of this committee are channelled to the Faculties and Departments through the *Joint Consultative Committee with Undergraduates*. This joint committee meets regularly once a term and discusses any matters that the MURC representatives wish to raise; in addition it has to consider matters relating to the synopses and proposed changes in syllabus.

The membership of the Joint Consultative Committee is twelve members of MURC appointed by MURC and representatives of the Faculties of Mathematics, of Computation and of Statistics. The committee is chaired by a Senior Member; the Secretary is an undergraduate member of the committee. The statistical feedback from the questionnaires is sent to a designated undergraduate member of MURC (the Questionnaire Representative) for consideration by MURC and it is also discussed by the Joint Consultative Committee. This committee is available for consultation by the Departments, and by the Divisional Board, on any matter which relates to the undergraduate courses.

The Chairperson and Secretary of MURC also attend meetings of the Faculty of Mathematics.

## 5.2 MURC Activities and Facilities

The programme of MURC activities and facilities is displayed on the MURC notice board beside the Institute lecture rooms. Information can also be found on the MURC website, http://www.maths.ox.ac.uk/∼murc

During the year, Open Days for prospective Mathematics students are run by the Mathematics Faculty in collaboration with MURC.

## 5.3 OUSU

Undergraduate representation at University (as opposed to subject or college) level is coordinated through *OUSU*, the Oxford University Student Union. Details of these arrangements can be found in **Essential Information for Students** (the

**Proctors' and Assessor's Memorandum**). Contact details for OUSU can be found in Appendix C.

## 5.4 College

College procedures for consultation, monitoring, and feedback vary; you will receive from your college details of these.

## 5.5 The Invariants

*The Invariants* is Oxford's student mathematics society, with the aim of introducing its members to a wide selection of mathematically-linked topics.

Meetings are held on Tuesdays at 8.00pm at the Mathematical Institute. These usually involve an informal talk on mathematics, followed by refreshments and the chance to talk to the guest speaker. No in-depth knowledge of mathematics is required, since all speakers are asked to make their talks accessible.

Recent talks have been on subjects as diverse as 'Magic Squares', 'How to build With Lego', and 'Applied Maths in the Real World'.

In addition to the weekly meetings, *The Invariants* also host a number of social events, including a Christmas Party and an annual formal dinner.

Anyone interested should come to the first meeting, which is free, to find out more.

## 5.6 The Proctors and Academic Appeals

In the rare case of any student wishing to make an appeal against an examination result, the appeal is usually made via the college to the Proctors' Office. However, students should be aware that they have the right to take certain matters to the Proctors directly (see Part II). Contact details can be found in Appendix C.

# Part V
# Syllabus and Lecture Synopses

You will be issued with the syllabus in supplement to your handbook. We have just completed the process of revising the syllabus; you will be issued with sections each year.

## 1 Moderations

For examination in 2007; this will be supplied with your **Handbook**.

## 2 Part A

For examination in 2008.

## 3 Part B

For examination in 2009.

## 4 Part C

For examination in 2010 (if applicable).

# Part VI
# Examination Regulations

You should always check with the current **Examination Regulations**, which can be consulted on the University website.

# Part VII
# University Regulations and Codes

## 1 The Proctors

The following is quoted from **Essential Information for Students** (the **Proctors' and Assessor's Memorandum**):

"The Proctors and Assessor are available if students wish to consult them in confidence for help, information, or advice about University matters or any other matters outside the sphere of their college advisers. Such requests may be on individual matters or on behalf of a club, society, or any other group of members of the University".

The duties of the Proctors and Assessor are now mainly:

- ensuring that regulations designed to maintain the orderly working of the University are implemented (this means that they play a major part in seeing that University examinations are conducted properly and fairly, and in enforcing student discipline);
- investigating any complaints by any member of the University (the Proctors have the power to summon any member of the University before them to help in their enquiries);
- serving on University committees (so that they can obtain wide experience of the University's administration, take part in decision-making, and provide feedback to colleges and student representatives).

## 2 Paperwork

The Proctors and Assessor have produced a booklet called **Essential Information for Students** which will be given to you by your college. This contains general information about health and welfare matters; the Student Union; accommodation; sport and recreation; transport; personal safety and security. It provides a source of information about the University's academic support services including the University Language Centre and Careers Services. The booklet also gives the University's formal, statutory rules and requirements in relation to Conduct of Examinations, Harassment, Freedom of Speech and explains complaints and appeals procedures. It is important for you to read this booklet in conjunction with the **Handbook** for your course.

## 3 Plagiarism

In these regulations: (1) 'examination' includes where the context so permits the submission and assessment of a thesis, dissertation, essay, or other coursework which is not undertaken in formal examination conditions but counts towards or constitutes the work for a degree or other academic award; and (2) 'examination room' means any room designated by the University's Clerk of the Schools or approved by the Proctors as a place for one or more candidates to take an examination.

**In any written work (whether thesis dissertation, essay, coursework, or written examinations) passages quoted or closely paraphrased from another person's work must be identified as quotations or paraphrases,**

**and the source of the quoted or paraphrased material must be clearly acknowledged.**

No candidate shall copy from the script of another candidate or in any other way dishonestly receive help from another person in an examination.

The University employs a series of sophisticated software applications to detect **plagiarism** in submitted examination work, both in terms of copying and collusion. It regularly monitors on-line essay banks, essay-writing services, and other potential sources of material. It reserves the right to check samples of submitted essays for plagiarism. Although the University strongly encourages the use of electronic resources by students in their academic work, any attempt to draw on third-party material without proper attribution may well attract severe disciplinary sanctions.

# 4 Code on Harassment

The Mathematical Institute has appointed two Senior Members who may be consulted in connection with the University's Code on Harassment. Details are posted in reception in The Mathematical Institute.

# 5 Disabilities and Equal Opportunities

The University is committed to making arrangements where appropriate to enable students with disabilities to participate fully in student life. Please see the University's Equal Opportunities Statement below, and the Mathematics Departmental Disability Statement in Appendix G.

# 6 University Equal Opportunities Statement: students

The University of Oxford and its colleges aim to provide education of excellent quality at undergraduate and postgraduate level for able students, whatever their background. In pursuit of this aim, the University is committed to using its best endeavours to ensure that all of its activities are governed by principles of equality of opportunity, and that all students are helped to achieve their full academic potential. This statement applies to recruitment and admissions, to the curriculum, teaching and assessment, to welfare and support services, and to staff development and training.

## 6.1 Recruitment and admissions

Decisions on admissions are based solely on the individual merits of each candidate, their suitability for the course they have applied to study (bearing in mind any requirements laid down by any professional body), assessed by the application of selection criteria appropriate to the course of study. Admissions procedures are kept under regular review to ensure compliance with this policy.

We seek to admit students of the highest academic potential. Except in respect of the college admitting women only, all selection for admission takes place without reference to the sex of the candidate. All colleges select students for admission without regard to marital status, race, ethnic origin, colour, religion, sexual orientation, social background or other irrelevant distinction.

Applications from students with disabilities are considered on exactly the same academic grounds as those from other candidates. We are committed to making

arrangements whenever practicable to enable such students to participate as fully as possible in student life. Details of these arrangements can be found in the University's Disability Statement, and information will be provided on request by colleges or by the University Disability Co-ordinator.

In order to widen access to Oxford, the University and colleges support schemes which work to encourage applicants from groups that are currently under-represented. The undergraduate Admissions Office can provide details of current schemes.

None of the above shall be taken to invalidate the need for financial guarantees where appropriate.

## 6.2 The curriculum, teaching and assessment

Unfair discrimination based on individual characteristics (listed in the statement on recruitment and admissions above) will not be tolerated. University departments, faculties, colleges and the central quality assurance bodies monitor the curriculum, teaching practice and assessment methods. Teaching and support staff have regard for the diverse needs, interests and backgrounds of their students in all their dealings with them.

## 6.3 Welfare and support services

Colleges have the lead responsibility for student welfare and can provide details of arrangements made to support their students. The University, in addition, provides for all students who require such support:

a counselling service;

childcare advice;

disability assessment and advice, and

a harassment advisory service.

Further details of these services are included in the Proctors' and Assessor's handbook 'Essential information for students', which is updated annually.

## 6.4 Staff development and training

The University, through its Institute for the Advancement of University Learning, will provide appropriate training programmes to support this statement.

## 6.5 Complaints

A candidate for admission who considers that he or she has not been treated in accordance with this policy, should raise this with the college concerned (or department in the case of graduate admission). Students in the course of their studies may use the student complaints procedure, and should, in the first instance, lodge their complaint with the Proctors, who will advise on the procedure to be followed thereafter. The Committee on Diversity and Equal Opportunity monitors complaints made by students.

# 7 Safety

You are urged to act at all times responsibly, and with a proper care for your own safety and that of others. Departmental statements of Safety Policy are posted in all departments, and you must comply with them. Students should note that they (and others entering onto Departmental premises or who are involved in Departmental activities) are responsible for exercising care in relation to themselves and others who may be affected by their actions.

They should also note that in the Institute accidents should be reported immediately to the Administrator in Room F13, telephone 73542, who keeps the Accident Book. First Aid boxes are located in the hallway on each floor.

Each Lecture Theatre has its own regulations for procedures to be followed in the case of Fire or other emergency; you are urged to familiarise yourself with the proper escape routes. The escape routes from the Mathematical Institute lecture and seminar rooms, where most of your lectures will be held, are set out on the next page. In the case of evacuation of the lecture theatre give heed to the instructions of the Lecturer.

# Part VIII
# Appendices

## A The Joint Courses

### A.1 Mathematics & Statistics

This Handbook applies to the first year in Mathematics and Statistics, which is shared with the single-subject degree. For other details about the course please see the separate Handbook and Statistics Department website.

### A.2 Mathematics & Computer Science

This is a brief overview of the course; for more details please see the separate handbook and Computing Laboratory website.

*Mathematics & Computer Science* is a three-year or four-year course intended to equip the future computer scientist with the fundamental understanding and practical skills needed by potential leaders of a demanding profession. It is a training in logical thought and is a good preparation for many occupations. The course concentrates on the areas in which mathematics and computing are most relevant to each other. It places emphasis on the bridges between hardware and software, and between theory and practice.

There is an examination at the end of the first year, called Honour Moderations in Mathematics & Computer Science. This consists of four papers: $CS_1$, $CS_2$, $M_1$, and $M_2$.

### A.3 Computer Science

There is a separate handbook for this course, and information can be found on theComputing Laboratory website.

### A.4 Mathematics & Philosophy

This is a brief overview of the first year of the course; for more details please see the separate Handbook.

*Mathematics & Philosophy* is a three-year or four-year course intended for those who would like to combine the development of their mathematical skills with the study of philosophy. There is a natural bridge in the philosophy of mathematics, as well as in logic. The latter has always been reckoned a part of philosophy, and over the last hundred years it has developed as a branch of mathematics.

There is an examination at the end of the first year, called Honour Moderations in Mathematics & Philosophy. This consists of four three-hour papers. Two of these papers, 'Pure Mathematics I' and 'Pure Mathematics II' also form part of the Mathematics courses. The lectures (and in most colleges the tutorials and classes) on the topics covered by these papers are the same as those attended by those sitting Honour Moderations in Mathematics; the examination papers are identical. The third paper is 'Elements of Deductive Logic'; candidates prepare for this paper by studying formal logic and its application to the analysis of English sentences and inferences, using the logical symbols and tableau rules of Hodges' *Logic*. There are university lectures and college-based classes or tutorials. The fourth paper is called 'Introduction to Philosophy' and for this paper students read certain prescribed

texts by Descartes and Frege, and are required in the examination to show knowledge of both authors. There are university lectures on each author, and college tutorials.

# B Examinations

## B.1 Moderations

### B.1.1 Examination Conventions

All Mathematics candidates take four papers, viz.

1. Pure Mathematics I (PMI)
2. Pure Mathematics II (PMII)
3. Applied Mathematics I (AMI)
4. Applied Mathematics II (AMII)

and submit two Maple projects.

The first two papers are also taken by candidates in *Mathematics & Philosophy*. Each paper has eight questions and candidates may submit answers to five questions. Each question is marked out of 20 marks and is divided into two or three parts. The marks for each part will be given on the examination paper. The paper Applied Mathematics I will be divided into two sections: (i) Calculus and Dynamics, and (ii) Probability and Statistics; four questions will be set on each section and candidates instructed that they should not submit answers to more than five questions in all and not more than three questions from either section. Marks will be reported in university standardised form (USM): 70+ a first class mark, 50-69 a second class mark, 40-49 a third class mark, 30-39 a pass mark, and *below* 30 a fail mark. Examiners may recalibrate the raw marks to arrive at university standardised marks reported to candidates. The standardised marks for written papers and marks for Maple projects (MM) will be averaged according to the following two formulae:

$$Av_1 = \frac{PMI + PMII + AMI + AMII + \frac{1}{4}MM}{4\frac{1}{4}},$$

$$Av_2 = \frac{PMI + PMII + AMI + AMII}{4},$$

rounded up to a whole number.

Classes will be awarded according to the following conventions:

First : $Av_1 \geq 70$

Second : $50 \leq Av_1 < 70$

Third : $40 \leq Av_1 < 50$ and $Av_2 \geq 40$

or

$40 \leq Av_2 < 50$;

Pass : $30 \leq Av_2 < 40$;

Fail : $Av_2 < 30$.

In addition to this, it should be noted that no student shall be awarded a Pass or Honours unless they score at least 30 on two papers.

A 'Preliminary Examination' is set for candidates who fail moderations or who, for some good reason, are unable to sit Moderations.

The Preliminary Examination consists of two papers; one in Pure Mathematics and one in Applied Mathematics. This is an unclassified examination. To pass the examination a student must achieve a USM of at least 40 on each of the two papers and demonstrate understanding of sufficient breadth to satisfy the Examiners.

## B.2 Qualitative description of examination performance for the various classes for each paper

**First Class:** the candidate shows excellent problem-solving skills and excellent knowledge of the material, and is able to use that knowledge in unfamiliar contexts.

**Second Class:** the candidate shows adequate basic to good problem-solving skills and (good) knowledge of much of the material.

**Third Class:** the candidate shows reasonable understanding of at least part of the basic material and some problem solving skills. Threshold level.

**Pass:** the candidate shows some limited grasp of basic material demonstrated by the equivalent of an average of one meaningful attempt at a question on each paper. A stronger performance on some papers may compensate for a weaker performance on others.

**Fail:** little evidence of competence in the topics examined; the work is likely to show major misunderstanding and confusion, coupled with inaccurate calculations; the answers to the questions attempted are likely to be fragmentary only.

### B.2.1 Advice from Examiners

The following is typical of recent letters of **Advice to Candidates** sent out by the Examiners and Moderators. It is offered here as a 'specimen', to give you an idea of how the Moderations examinations will be organised.

**Arrangements for the examination:**

Papers will be sat in the Ewert House, Summertown, starting at either 9.30 or 2.30. You will be allowed to enter a few minutes before this time to get settled; in particular, I hope to allow extra time for you to find your places before the first paper, but in any case, apart from any latecomers, the examination will not start until everyone is seated. You may remove your gown, jacket and tie, but you must put them on again before leaving your desk at the end of the examination. There will be an area near the entrance where coats and bags must be left; you may take one transparent pencil case containing personal items, and writing equipment into the examination area, and these may be inspected. In particular, you may not take in mobile phones, books, diaries, notebooks or any paper, nor may you take in any food or drink unless it is medically required and approved by the Proctors - the Moderators will have been informed in these cases. **Calculators will not be allowed.**

You should note that you are required to remain in the examination hall until at least 30 minutes have elapsed from the actual start. If you arrive late you will not receive extra time to make up for this and if you are more than 30 minutes late, you will be allowed to enter, but your late arrival will be reported and your script may not be marked.

Desks will be grouped by subject, and this will be clearly indicated; seating within

each subject will be in alphabetical order, with desks having your name on them. You should try to remember your examination candidate number since this is the only identification that you are permitted to write on your scripts; however, there is a master list in case you have forgotten, but you will then have to wait at the end of the examination before handing in your script. The examination paper and answer booklets will be on your desk before you are allowed in. There are no questions visible on the front of the examination paper, and you may not open it until told to. The paper in the answer booklets is unlined.

- **On papers A, B and D you should submit answers to no more than five questions. On paper C there will be two sections and you should submit answers to no more than five questions in all, with no more than three questions from section (i) and no more than three questions from section (ii)**
- **Begin each question in a new answer booklet**
- **Hand in your answers in numerical order**
- **Write the numbers of all the questions to be marked on the front answer booklet.**
- **If you answer fewer than five questions you must submit an empty answer booklet for each unanswered question, so that you still submit at least five booklets in total.** (For example, if you answer three questions you should also submit two empty answer booklets with your candidate number on the front page.)
- **Cross out all rough working and any working you do not want to be marked. If you have used separate answer booklets for rough work please cross through the front of each such answer booklet and attach these answer booklets at the back of your work.**

You are reminded also of the rule that you may not write in pencil, except to draw diagrams.

If you have been given permission by the Proctors to use a dictionary, you should show it to me at the beginning of the Examination. It must then remain in the Examination Hall until the end of the entire Examination, and you should hand it to the Moderator invigilating at the end of each paper.

Make sure that every booklet has your number on it. At the end on the examination, you will be told to stop writing, and should do no more than complete the line you are writing. **Please ensure that you have written the numbers of the five (or fewer) questions that you want marked on the front answer booklet, that you have crossed through any working that you do not want to be marked.** You should then hand in scripts as directed by the Invigilators.

If you wish to leave the examination hall at any time during the examination, to attend the lavatory or obtain a drink of water, raise your hand and wait for an invigilator to escort you out. Similarly, if you feel unwell, or wish to leave the examination early, wait for an invigilator to come, but then ask to see the Moderator present since only he can record your incapacity or early departure. You will not be permitted to leave the Examination Hall because of illness and then return, on more than one occasion during a single examination. You will not be allowed to leave during the last 30 minutes of a paper, except in the case of illness, to avoid

disruption to other candidates or to the orderly collection of scripts. Candidates in Mathematics and Philosophy will be instructed on the number of questions to be attempted on Philosophy papers.

## B.3 Finals

### B.3.1 Classification in the Mathematics Degrees

Each candidate will receive a numerical mark on each paper in each Part of the examination in the University standardised range 0-100, such that

- a First Class performance (on that paper) is indicated by a mark of 70 to 100;
- an Upper Second Class performance (on that paper) is indicated by a mark of 60 to 69;
- a Lower Second Class performance (on that paper) is indicated by a mark of 50 to 59
- a Third Class performance (on that paper) is indicated by a mark of 40 to 49;
- a Pass performance (on that paper) is indicated by a mark of 30 to 39;
- a performance at the level of a Fail (on that paper) is indicated by a mark of 0 to 29.

In order to arrive at such University standardized marks (or USMs) for each paper, the examiners will mark and assess papers in the ways described below.

**Part A**

**The Examination Papers**

There are four papers in Part A, all of 3 hours. In the order in which they will be taken, these are AC1, AC2, AO1 and AO2. Questions on AC1 and AO1 are shorter and will be marked out of 10, while questions on AC2 and AO2 are longer and will be marked out of 25. There will be 9 questions on paper AC1 and candidates should attempt them all. There will be 9 questions on paper AC2 and candidates may hand in answers to at most 5, from which the best 4 answers will be counted towards the mark for this paper. There will be 19 questions on paper AO1, 1 for each 8 lecture course and 2 for each 16 lecture course, and candidates may hand in answers to at most 10, from which the best 9 answers will be counted towards the mark for this paper. There will be 19 questions on paper AO2, distributed among the courses as in AO1, and candidates may hand in answers to at most 5, from which the best 4 marks will be counted towards the mark for this paper.

**Marking of Papers**

Mark schemes for questions out of 10 will aim to ensure that the following qualitative criteria hold:

- 9-10 marks: a completely or almost completely correct answer, showing good understanding of the concepts and skill in carrying through arguments and calculations; minor slips or omissions only.

- 5-8 marks: a good though not complete answer, showing understanding of the concepts and competence in handling the arguments and calculations.

Mark schemes for questions out of 25 will aim to ensure that the following qualitative criteria hold:

- 21-25 marks: a completely or almost completely correct answer, showing excellent understanding of the concepts and skill in carrying through the arguments and/or calculations; minor slips or omissions only.

- 13-20 marks: a good though not complete answer, showing understanding of the concepts and competence in handling the arguments and/or calculations. In this range, an answer might consist of an excellent answer to a substantial part of the question, or a good answer to the whole question which nevertheless shows some flaws in calculation or in understanding or in both.

**Parts B and C**

**The Examination Papers**

Where not otherwise stated, the syllabus and form of the papers for each unit and half unit is defined by the lecture synopsis.

**Analysis of marks**

**Part A**

At the end of the Part A examination, a candidate will be awarded a University standardised mark (USM) for each of the four papers. The Examiners will recalibrate the raw marks to arrive at the USMs reported to candidates. In arriving at this recalibration, the examiners will principally take into account the total sum over all four papers of the marks for each question, subject to the rules above on numbers of questions answered.

The Examiners aim to ensure that all papers and all subjects within a paper are fairly and equally rewarded, but if in any case a paper, or a subject within a paper, appears to have been problematical, then the Examiners may take account of this in calculating USMs.

The USMs awarded to a candidate for papers in Part A will be carried forward into a classification as described below.

**Part B**

The Board of Examiners in Part B will assign USMs for full unit and half unit papers taken in Part B and may recalibrate the raw marks to arrive at university standardised marks reported to candidates. The full unit papers are designed so that the raw marks sum to 100, however, Examiners will take into account the relative difficulty of papers when assigning USMs. In order to achieve this, Examiners may use information on candidates' performances on the Part A examination when recalibrating the raw marks. They may also use other statistics to check that the USMs assigned fairly reflect the students' performances on a paper.

The USMs awarded to a candidate for papers in Part B will be aggregated with the USMs from Part A to arrive at a classification.

**Part C**

The Board of Examiners in Part C will assign USMs for full unit and half unit papers taken in Part C and may recalibrate the raw marks to arrive at university standardised marks reported to candidates. The full unit papers are designed so that the raw marks sum to 100, however, Examiners will take into account the relative difficulty of papers when assigning USMs. In order to achieve this, Examiners may use information on candidates' performances on the earlier Parts of the examination when recalibrating the raw marks. They may also use other statistics to

check that the USMs assigned fairly reflect the students' performances on a paper. The USMs awarded to a candidate for papers in Part C will be aggregated to arrive at a classification for Year 4.

**Aggregation of marks**

**All successful candidates will be awarded a classification at the end of three years, after the Part B examination. This classification will be based on the following rules (agreed by the Mathematics Teaching Committee).**

$AvUSM - PartA\&B = Average\ weighted\ USM\ in\ Parts\ A\ and\ B\ together$ (rounded up to whole number);

The Part A USMs are given a weighting of 2, and the Part B USMs a weighting of 3 for a full unit and 1.5 for a half unit.

- First Class: $AvUSM - PartA\&B >= 70$ with not more than 2 weak papers ($USM < 50$)
- Upper Second Class: $AvUSM - PartA\&B >= 70$ with more than 2 weak papers ($USM < 50$) or $70 > AvUSM - PartA\&B >= 60$ and not more than 2 very weak papers ($USM < 40$)
- Lower Second Class: $70 > AvUSM - PartA\&B >= 60$ and more than 2 very weak papers ($USM < 40$) or $60 > AvUSM - PartA\&B >= 50$
- Third Class: $50 > AvUSM - PartA\&B >= 40$
- Pass: $40 > AvUSM - PartA\&B >= 30$
- Fail: $AvUSM - PartA\&B < 30$

[Note: Half unit papers count as half a paper when determining the average USM, or determining the number of weak or very weak papers.]

**BA in Mathematics**

All candidates who satisfy the Examiners will be awarded a classified BA in Mathematics at the end of Part BF.

**MMath in Mathematics**

In order to proceed to Part C, a candidate must achieve Honours standard (First class, Upper Second class, Lower Second class or Third class) in Part A and Part B together.
Candidates successfully studying for a fourth year will receive a separate classification based on their University standardised marks in Part C papers, according to the following rules (agreed by the Mathematics Teaching Committee).
$AvUSM - PartC = Average\ USM\ in\ Part\ C$ (rounded up to whole number)

- First Class: $AvUSM - PartC >= 70$
- Upper Second Class: $70 > AvUSM - PartC >= 60$
- Lower Second Class: $60 > AvUSM - PartC >= 50$
- Third Class: $50 > AvUSM - PartC >= 40$

[Note: Half unit papers count as half a paper when determining the average USM.]

Candidates leaving after four years who satisfy the Examiners will be awarded an MMath in Mathematics, with two associated classifications; for example:
MMath in Mathematics: Years 2 and 3 together - First class; Year 4 - First class
A 'Pass' will not be awarded for Year 4. Candidates achieving:

$$AvUSM - PartC < 40,$$

may supplicate for a BA.

**Descriptors**
The average USM ranges used in the classifications reflect the following descriptions:

- First Class: the candidate shows excellent problem-solving skills and excellent knowledge of the material, and is able to use that knowledge in unfamiliar contexts.
- Upper Second Class: the candidate shows good problem-solving skills and good knowledge of much of the material.
- Lower Second Class: the candidate shows adequate basic problem-solving skills and knowledge of much of the material.
- Third Class: the candidate shows reasonable understanding of at least part of the basic material and some problem solving skills. Threshold level.
- Pass: the candidate shows some limited grasp of basic material demonstrated by the equivalent of an average of one meaningful attempt at a question on each unit of study. A stronger performance on some papers may compensate for a weaker performance on others.
- Fail: little evidence of competence in the topics examined; the work is likely to show major misunderstanding and confusion, coupled with inaccurate calculations; the answers to questions attempted are likely to be fragmentary only.

### B.3.2 Advice from Examiners

You will receive advice from the Examiners before each part of your finals examination, giving more information. Notices form Examiners in previous years can be found on the Mathematical Institute website.

# C Contact Points

## C.1 Mathematical Institute

**Director of Undergraduate Studies** Dr A Curnock
email: curnock@maths.ox.ac.uk

**Faculty Chairman** Dr G L Luke (tel: 74943)
email: glenys.luke@st-hughs.ox.ac.uk

**Academic Administrator** Ms C Goodwin (tel: 73530)
email: academic.administrator@maths.ox.ac.uk

**Deputy Academic Adminstrator** Mr Yan Chee Yu (tel: 73546)
email: yuy@maths.ox.ac.uk

**Academic Assistant** Miss S Souchtchenko (tel: 73547)
email: souchtch@maths.ox.ac.uk

## C.2 Faculty of Statistics

**Chairman of Academic Committee** Dr Matthius Winkel (tel: 72875)
email: winkel@stats.ox.ac.uk

**Academic Administrator** Ms J Boylan (tel: 72860)
email: boylan@stats.ox.ac.uk

## C.3 Faculty of Computer Science

**Chairman of Teaching Committee** Dr G Lowe (tel: 73841)
email: Gavin.Lowe@comlab.ox.ac.uk

**Academic Administrator** Mrs C O'Connor (tel: 73863)
email: Christine.OConnor@comlab.ox.ac.uk

## C.4 Projects Committee

**Chairman** Dr P Neumann (tel: 79178)
email: peter.neumann@queens.ox.ac.uk

## C.5 Careers Service

**Enquiries** (tel: 74646)

**Mathematics Link** Ms N Lunsteen (tel: 74659)
email: natalie.lunsteen@cas.ox.ac.uk

## C.6 MURC

**General**
webpage: http://www.maths.ox.ac.uk/ ∼murc

**Chairperson** James Holwell, Exeter College
email: james.holwell@exeter.ox.ac.uk

## C.7 Invariants

**Secretary** David Sims, Mansfield College
email: david.sims@mansfield.ox.ac.uk

## C.8 General

**Disabilities Office** (tel: 80459) email: disability@admin.ox.ac.uk

**Counselling Service** (tel:70300)

**Proctors' Office** (tel: 70090)
email: Proctors.office@admin.ox.ac.uk

**Equal Opportunities Officer** (tel: 89821)
email: equal.opportunities@admin.ox.ac.uk

**Resources for the Blind** (tel: 80880)
email: km@bodley.ox.ac.uk

**Oxford University Student Union, Vice President (Welfare)** (tel: 88450)
email: welfare@ousu.org

# D Questionnaires

The next page gives a specimen of the Questionnaires used to monitor the effectiveness of the teaching. The system is described above in Section 2.6. Your comments will be stored on our database and used by lecturers to inform their future teaching. We urge you to fill in the questionnaires **for every course you take**, and hope that you will take the opportunity to **make constructive criticisms** which will help us in our teaching.

# E Policy on Intellectual Property Rights

The University of Oxford had in place arrangements governing the ownership and exploitation of intellectual property generated by students and researchers in the course of, or incidental to, their studies. These arrangements are set out in the University's *Statutes* 2000 (page 121 refers) under which the University claims ownership of certain forms of intellectual property which students may create. The main provisions in the *Statutes* are as follows.

**Section V. Of intellectual property generated by students**

1. Subject to clause 2 below and to the provisions of the Patents Act 1977, and unless otherwise agreed in writing between the student concerned and the University in relation to any particiular piece of intellectual property, the University claims ownership of the following forms of intellectial property; in the case of (*c*), (*d*), (*e*) and (*f*) (and(*g*) as it relates to (*c*)-(*f*)) the claims are to intellectual property devised, made, or created but students in the course of or incidentally to their studies:

(*a.*) works generated by computer hardware or software owned or operated by the University;

(*b.*) films, video's, multimedia works, typographical arrangements, and other works created with the aid of University facilities

(*c.*) patentable and non-patentable inventions;

(*d.*) registered and unregistered designs, plant varities, and topographies;

(*e.*) university-commissioned works not within *(a)*, *(b)*, *(c)* or *(d)*;

(*f.*) databases, computer software, firmware, courseware, and related material not within *(a)*, *(b)*, *(c)* *(d)*, or *(e)*, but only if they may reasnably be considered to possess commercial potential; and

*(g.)* know-how and information associated with the above

2. Not withstanding clause 1 above, the University shall not assert any claim to the ownership of copyright in:

(*a.*) artistic works, books, articles, plays, lyrics, scores, or lectures, apart from those specifically commissioned by the university

(*b.*) audio or visual aids to the giving of lectures; or

(*c.*) computer-related works other than those specified in clause 1 above .

3. For the purpose of clauses 1 and 2 above:

(*a.*) a 'student' is a person reading and registered for a degree, diploma, or certificate of the University;

(*b.*) 'commissioned works' are works which the University has specifically requested the student concerned to produce, whether in return or a special payment or not. However save as may be separately agreed between the University Press and the student concerned, works commissioned by the Universty Press in the course of its publishing business shall not be regarded as 'works commissioned by the University'.

# F Email - Important information for students in Mathematics and Mathematics & Statistics

You will be allocated a college email account. Important information about your course will be sent to this account. If you do not plan to read it regularly you should ensure that you arrange for mail to be forwarded to an account which you do read regularly. You are asked to bear in mind that lost email is the students' responsibility should they choose to forward email to a system outside the university.

# G Mathematical Institute Departmental Disability Statement

The Institute will do everything within its power to make available its teaching and other resources to students and others with disabilities to ensure that they are not at a disadvantage. In some cases, this may require significant adjustments to the building and to teaching methods. Those with disabilities are encouraged to discuss their needs with the Academic Administrator [tel: 01865 273530, email academic.administrator@maths.ox.ac.uk] at the earliest possible opportunity.

The Executive Committee is responsible for the department's disability policy.

Undergraduates are asked also to contact the Academic Administrator, academic.administrator@maths.ox.ac.uk, who will notify those directly involved with teaching and scheduling lectures. For instance, students with visual impairment might have lectures in rooms with whiteboards; students who are hard of hearing might have their lectures scheduled in a room with an induction loop. In some instances, it may be possible for lecturers to provide students with lecture notes, even when they are not posted on the Mathematical Institute website.

# H Mathematical Institute Complaints - Complaints within the Department

Undergraduates with a complaint should first normally discuss it with their college tutor.

If the concern or complaint relates to teaching or other provision **made by the faculty/department** then the student should raise it with the Director of Undergraduate Studies (Dr A. G. Curnock). Within the faculty/department the officer concerned will attempt to resolve your concern/complaint informally.

If you are dissatisfied with the outcome, then you may take your concern further by making a formal complaint to the University Proctors. A complaint may cover aspects of teaching and learning (e.g. teaching facilities, supervision arrangements etc), and non-academic issues (e.g. support services, library services, university accommodation, university clubs and societies, etc.) A complaint to the Proctors should be made only if attempts at informal resolution have been unsuccessful.

In thinking about causes of concern/complaint, please bear in mind that the first step if at all possible is to raise the matter that is troubling you with the person who is immediately responsible. If this is difficult, then many sources of advice are available within colleges, within faculties/departments and from bodies like OUSU or the Counselling Service, which have extensive experience in advising students. General areas of concern about provision affecting students as a whole should, of course, continue to be raised through Joint Consultative Committees via student representation on the faculty/department's committees.

If your concern or complaint relates to teaching or other provision **made by your college**, then you should raise it with your tutor or with one of the college officers, e.g. Senior Tutor. Your college will also be able to explain how to take your complaint further if you are dissatisfied with the outcome of its consideration. Further information can be obtained from the Proctors Memorandum.