HANDBOOK FOR THE UNDERGRADUATE MATHEMATICS COURSES

ISSUED OCTOBER 2010

The Mathematical Institute Mission Statement

Mathematics is central to our understanding of the world in which we live, to our control of our environment, and to the organisation of our society. It underpins science, technology, medicine, economics and government. The preservation and propagation of mathematics is essential if civilization is to flourish. But this is a requirement that goes far beyond the simple recording and transmission of techniques of calculation and analysis. If Society is to benefit from mathematics, it must nurture a mathematical culture by promoting a pervasive understanding of the mathematical way of thought and by supporting the study of mathematics for its own sake.

Those who teach mathematics at every level must be able to see beyond the horizons set by the problems at hand, otherwise they will convey no more than the means of mechanical execution. Without a broader appreciation of their subject, they will not pass on the understanding that is required for creativity, nor will they instil a proper appreciation of the beauty and universality of the mathematical ideas.

The mission of the Mathematical Institute is the preservation and expansion of mathematical culture. Our goals are to extend our own horizons through research at the highest level; to support the propagation and exploitation of mathematical ideas through publication and by reaching out to the public; to train our students, graduate and undergraduate, in the practice of mathematics; and to educate them in the ways of mathematical thinking. By these means, and by teaching those who will themselves carry forward our mission, we seek to extend the benefits of mathematical understanding.

Contents

1 Using this Handbook

This **Handbook** is intended as a guide and reference for you throughout your Mathematics course at Oxford. The information is for students matriculating in October 2010. Please keep it as a handy reference guide. It will be useful for you at the start of each year and when you are planning some reading over the summer (the Long Vacation) for your following year.

It supplements the material printed in the **Examination Regulations**. The **Handbook** read in conjunction with its supplements defines the syllabus, provides you with information to help you understand the processes and procedures of the Department and about the Mathematical Institute, and the other facilities such as libraries and computers to which you have access. It gives you information on how you will be assessed and how your examinations are classified. You are supplied with the **Handbook** at the beginning of your course and will be informed by your tutors when you should collect supplements - including the **Synopses of lecture courses** for each year of your course. All this material is also published on the Mathematical Institute website.

The **Handbook** also gives you some information about how colleges work in relation to your Mathematics course. Your college tutors will give you more detailed information about the support provided within the tutorial system.

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 those 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 Important Documents

General regulations for the examination structure and conduct are published by the University in the **Examination Regulations**, known as 'The Grey Book'. The information is also available online at `http://www.admin.ox.ac.uk/examregs/` and `http://www.ox.ac.uk/students/examinations_assessments/`. If any information in the **Examination Regulations** affecting you is changed you will be informed. However, there is a convention that the syllabus cannot be changed to your disadvantage once you have started studying for the examination concerned, provided you take your examinations at the normal times. At the start of each year the Mathematics Department produces the syllabuses for the coming year's examinations and synopses of lectures. The synopses state the intended content of lecture courses but lecturers may include extra material enhancing the syllabus but which is not examinable. For each of Moderations and Part A, a formal syllabus giving the examinable content is published. For Parts B and C the syllabuses are defined by the synopses. At the induction session new students will be provided with hard copy of the Moderations syllabuses and synopses of lectures. It is also available online (`http://www.maths.ox.ac.uk/current-students/undergraduates/handbooks-synopses/`), as are the syllabuses and synopses for latter parts of the course. Any student may obtain a printed copy of this

information on request from the Reception at the Mathematical Institute. Please note, recommended reading is included with synopses.

In addition, guides to certain other courses, for example, the first-year **MuPAD** course, will be provided. Copies of **examination papers** from previous years are available. Those from years up to 1999 may be obtained from the **Examination Schools** but those more relevant to you, from 2000, can be accessed online at `http://www.ox.ac.uk/current-students/undergraduates/examinations/past-papers/`. Previous papers provide useful practice questions but please note that previous papers will often be set on different syllabuses and you will need to be guided to relevant questions by your tutors. Students will find past papers most valuable when used in conjunction with corresponding examiners' reports which are posted online at `http://www.oxam.ox.ac.uk`.

In addition to subject specific guides, you will receive other information about your college's regulations and requirements and more generally, **Essential Information for Students** (the Proctors' and Assessors' Memorandum, which is also available online at `http://www.admin.ox.ac.uk/proctors/info/index.shtml`). **Lecture lists** giving titles, times and places of lectures for Mathematics courses are available online at `http://www.maths.ox.ac.uk/notices/lecture-lists/`. These are usually also available through your college tutors.

2 Your First Weeks at Oxford University

Many of you will already have read 'How do Undergraduates do Mathematics?' prepared by Professor Charles Batty with the assistance of Professor Nick Woodhouse. If you have not done so, then it is available online at `http://www.maths.ox.ac.uk/files/study-guide/index.shtml` and you are strongly recommended to read it as part of the induction to your course.

The Department Induction session is held at 2pm on Friday Week 0 in the University Museum lecture theatre at which you will be given final documentation for your course. Further useful information can be found at `http://www.maths.ox.ac.uk/current-students/undergraduates/making-most-your-degree`.

The Oxford mathematics students have also developed a useful website, `http://people.maths.ox.ac.uk/~murc/`, and "Guide to Freshers". This guide is produced by students and you may find it helpful to read their briefer more informal view on what you need to know at the beginning of your course.

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 then you should 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.

For remote access to the University's restricted site you will need to use the University's VPN service. See the Maths Institute's IT Notices page `http://www.maths.ox.ac.uk/help/faqs/undergrads`

Useful 'Web' addresses

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

Statistics Department
`http://www.stats.ox.ac.uk/`

Computing Laboratory
`http://www.comlab.ox.ac.uk/`

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

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

Information about remote access to the University restricted pages (VPN service)
`http://www.maths.ox.ac.uk/help/faqs/undergrads`

MuPAD information - access
`http://www.stats.ox.ac.uk/about_us/it_information/restrictedaccess/undergraduate_maple_server`

Archive of past exam papers 2000–2010
`http://www.oxam.ox.ac.uk/`

Unofficial archive of past exam papers 1991–2010
`http://www.maths.ox.ac.uk/current-students/undergraduates/examinations/past-papers`

Examiners' reports 2000-2010
`http://www.maths.ox.ac.uk/notices/exam-reports/`

How do Undergraduates do Mathematics? Notes by Charles Batty
`http://www.maths.ox.ac.uk/files/study-guide/index.shtml`

Information on the Joint Consultative Committee for Undergraduates
`http://www.maths.ox.ac.uk/current-students/undergraduates/jccu`

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 Director of Undergraduate Studies 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 `(6)15203`.

3 The Mathematics Courses

3.1 Aims and Structure

3.1.1 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.

3.1.2 Overall Course Structure

The degree programmes listed in 3.1.1 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 (see 3.5 Exit Points).

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 examinations, by implication, cover earlier core work!)

The first year examination is called **Honour Moderations**, 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 or tutorials, and, where appropriate, practical work. In the third and fourth years, there may be some reading courses involving prescribed reading and group meetings.

Assessment is normally by written examination. However, some half units are assessed by coursework for which projects or extended essay are submitted. Further details can be found in the supplements you will receive as you progress through each year of the course. If you want to look ahead, the current supplements are available online. Normally

examination papers for whole units are of three hours duration, except where coursework is involved.

3.2 Background

Oxford University is a large collegiate university, with over 20,000 students including 11,765 undergraduates and 8,701 postgraduates.

3.2.1 Some Facts and Figures

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

- offers made for October 2010 were 251; being 184 for the single subject courses, 21 for *Mathematics & Computer Science*, 17 for *Mathematics & Philosophy*; 29 for *Mathematics and Statistics*
- of these 176 were men and 75 women.
- the last-examined fourth year numbered 148 ; being 106 in *Mathematics*, 13 in *Mathematics & Computer Science*, 17 in *Mathematics & Philosophy* and 12 in *Mathematics & Statistics*;
- students are carefully selected taking into account test, interview, references, and therefore few drop out or fail, almost none later than the first year;
- for degree results please see sections 7.5.2 and 7.5.3;
- the most recent available results on first employment for mathematics students can be found at `http://www.maths.ox.ac.uk/node/7077`

3.2.2 Academic Staff

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 2008 'RAE') showed that Oxford mathematicians were assessed extremely highly with a significant percentage of faculty with internationally renowned reputations. Detailed information on academic staff is to be found in Appendix E.

3.2.3 The Departments

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 currently 12 statutory chairs held in the department, with at 6 statutory chairs in Pure Mathematics and at 6 statutory chairs in Applied Mathematics though 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 and the newly established Oxford Centre for Collaborative Applied Mathematics. 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/`.

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/`.

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 Computing Laboratory by visiting the website:
`http://www.comlab.ox.ac.uk/`.

3.3 The First Year

The first year course is run as a joint venture with the Statistics Department. The official first year syllabus for the Honour Moderations Examination for 2010/11 is in a separate booklet which will be supplied together with this handbook at the induction session. Lecture synopses are included in this additional booklet. The lecture courses form a co-ordinated programme, ensuring full and careful coverage, avoiding unnecessary duplication to help you prepare for the examinations. They give a full and careful coverage of the syllabus. Reading lists are given alongside the synopses.

3.3.1 The Lecture Courses

The lecture courses in the first year are as follows:

Michaelmas Term

Introduction to Pure Mathematics	6 lectures
Introduction to Complex Numbers	2 lectures
Linear Algebra I	14 lectures
Geometry I	7 lectures
Analysis I	14 lectures
Calculus of One Variable	6 lectures
Dynamics	16 lectures
Probability I	8 lectures
Calculus of Two or More Variables	10 lectures

Hilary Term

Linear Algebra II	8 lectures
Introduction to Groups, Rings and Fields I	8 lectures
Analysis II	16 lectures
Probability II	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

Introduction to Groups, Rings and Fields II	8 lectures
Geometry II	8 lectures
Analysis III	8 lectures
Calculus in Three Dimensions and Applications	16 lectures

3.3.2 The MuPAD 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 MuPAD". 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 university network. You will be allocated an account before the course begins. Practicals are done in the teaching laboratory in the Department of Statistics on South Parks Street.

Access to the Department of Statistics during normal working hours is by using your University Card.

Further details are available at
`http://www.stats.ox.ac.uk/about_us/it_information/restrictedaccess/undergraduate_maple_server`

Undergraduates may also use college computers where these are available; with appropriate software supplied by colleges it is possible to log-on to your University email account, and run MuPAD from a college machine. Undergraduates may also obtain a free license to run MuPAD on their own computers. Using your student ID number we will register all first year students here in the department to use MuPAD on their own computers. By accepting a copy of MuPAD from the Department you are stating your agreement that this version is for your own personal use alone, in order that your use is covered by our departmental license. The Matlab software needed can be downloaded from `http://www.oucs.ox.ac.uk/sls/matlab.xml.ID=body.1_div.2`.

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 MuPAD 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 submitting MuPAD projects. Failure to meet the deadlines may mean that the work will not be taken into account. For 2010/2011 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 unaided work.

Students transferring into Mathematics from any other subject will still be expected to submit two MuPAD projects (but may be granted extensions to deadlines).

Students who do not have their own computer or whose college has limited computing facilities may, with permission, use the small computing facility in Dartington House. You need to ask about this - please contact the Academic Administrator, if this concerns you. (academic.administrator@maths.ox.ac.uk).

Plagiarism : the University and Mathematical Institute regard plagiarism as a serious issue.

Any attempt to submit another's work as your own or to make use of published sources without explicit reference to them will be regarded as an infringement of University's code concerning academic integrity. Your attention is drawn to the *Proctors' and Assessor's Memorandum,* Section 9.5, "Conduct in Examinations" which covers all forms of assessment. See also **section 8.3** for further information.

Candidates who miss the above deadlines may ask their college to apply to the Chairman of Mathematics for permission to submit late. Where there is a valid reason, the Chairman would normally approve the late submission without penalty. Where it is deemed that there is no valid reason the Chairman of Mathematics will advise the Moderators to apply a penalty of at least 5% of the marks.

3.3.3 Changing Course

Your college will have admitted you to study a particular course and you will need their permission to change course, this includes changing between single subject and joint Mathematics courses. You may be given permission to change without taking an extra year. This is usually only possible during the first year of the course. If given permission then you will need to catch up the work missed.

3.4 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 depending on faculty interests and current research interests. The lists in the following sections show the options available in the academic year 2010-11. You will receive information on the options, year by year, when it becomes available.

3.4.1 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:

Introduction to Fields,
Group Theory,
Number Theory,
Integration,
Topology,
Multivariable Calculus,
Calculus of Variations,
Classical Mechanics,
Quantum Theory,
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. Most students aim to prepare the equivalent of 72-80 lectures of options but your college tutor will advise.

The Mathematical Institute is responsible for the delivery of all units except for those on Probability and Statistics, which are the responsibility of the Department of Statistics.

3.4.2 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.

Units and half units are designated either at H-level (aimed at the third year undergraduates) or M-level (aimed primarily at the fourth year or M.Sc. students).

3.4.3 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 background reading.

3.4.4 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. Below we give the lists of Part B and C options delivered in 2010-11. We anticipate those available when you come to your third and fourth years will be broadly similar.

Part B Units and Half Units in 2010-11

Mathematics Department Units and Half Units

- B1 Foundations Logic and Set Theory
  - B1a Logic — MT (half unit)
  - B1b Set Theory — HT (half unit)
- B2 Algebra — MT & HT (whole unit)
  - B2a Introduction to Representation Theory — MT (half unit)
  - B2b Group Theory — HT (half unit)
- B3 Geometry
  - B3a Geometry of Surfaces — MT (half unit)
  - B3b Algebraic Curves — HT (half unit)
- B3.1a Topology and Groups
- B4 Analysis
  - B4a Banach Spaces — MT (half unit)
  - B4b Hilbert Spaces — HT (half unit, cannot be taken unless B4a is taken)

- B568 Introduction to Applied Mathematics
- B5 Applied Differential Equations and Applications
  - B5a Techniques of Applied Mathematics — MT (half unit)
  - B5b Applied Partial Differential Equations — HT (half unit)
- B5.1a Dynamics and Energy Minimization
- 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 and Electromagnetism — MT (half unit)
  - C7.1b Quantum Theory and Quantum Computers — HT (half unit, cannot be taken unless B7.1a is taken)
- B7.2
  - B7.2b Special Relativity and Electromagnetism — MT (half unit)
- B8 Topics in Applied Mathematics
  - B8a Mathematical Ecology and Biology — MT (half unit)
  - B8b Nonlinear Systems — HT (half unit)
- B9 Number Theory
  - B9a 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)
- B11a Communication Theory — MT (half unit)
- B12a Applied Probability — 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)
- B22a Integer Programming — MT (half-unit)
- BE “Mathematical” Extended Essay (whole unit)

- BSP: Structured project (Mathematical Modelling and Numerical Computation), MT & HT (whole unit)

Other Mathematical Units and Half Units

- O1 History of Mathematics — MT & HT (whole unit)
- MS: Statistics Units and Half-Units
- Computer Science: Half Units
- OE: "Other Mathematical" Extended Essay

Other Non-Mathematical Units and Half Units

- N1 Mathematical Education and Undergraduate Ambassadors' Scheme — (MT, HT) (whole unit)
  - N1a Mathematics Education (half unit)
  - N1b Undergraduate Ambassador's Scheme — mainly HT (half unit)
- Philosophy: Units and Half-units

Language Classes: French

Part C Units and Half Units to be delivered in 2010-11

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 Analytic Topology and Axiomatic Set Theory
  - C1.2a Analytic Topology — MT (half unit)
  - C1.2b Axiomatic Set Theory — HT (half unit)
- C2.1 Lie Algebras and Representation Theory of Symmetric Groups
  - C2.1a Lie Algebras — MT (half unit)
- C2.2a Finite Group Theory — MT (half unit)
- C2.2b Building Infinite Groups — HT (half unit)
- C3.1a Algebraic Geometry — 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)

- C5.1 Methods of Functional Analysis
  - C5.1a Methods of Functional Analysis for Partial Differential Equations — MT (half unit)
  - C5.1b Fixed Point Methods for Nonlinear Partial Differential Equations — HT (half unit)
- C5.2 Calculus of Variations — HT (half unit)
- C6.1a Solid Mechanics — MT (half unit)
- C6.1b 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)
- C6.4a Topics in Fluid Mechanics — MT (half unit)
- C7 Mathematical Physics
  - C7.1b Quantum Theory and Quantum Computers — HT (half unit)
  - C7.2a General Relativity — MT (half unit)
- C7.4 Theoretical Physics — MT and HT (whole unit)
  - C7.4a Theoretical Physics I — MT (half-unit)
  - C7.4b Theoretical Physics II — HT (half-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 Optimization
  - C12.1a Numerical Linear Algebra — MT (half unit)
  - C12.1b Continuous Optimization — HT (half unit)
- C12.2 Approximation Theory and Finite Element Methods
  - C12.2a Approximation of Functions — MT (half unit)
  - C12.2b Finite Element Methods for Partial Differential Equations — MT (half unit)
- CD Dissertations on a Mathematical Topic — half unit or whole unit
- Extra Units - application required
  - C2.1b Representation Theory of Symmetric Groups — HT (half unit)

Other Mathematics Units and Half 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)
- MS3b Lévy Processes and Finance — HT (half unit)
- MS5b High-throughput Data Analysis — HT (half unit)
- MS6a The Analysis of Biological Networks — MT (half unit)

COMPUTER SCIENCE: Half Units

- CCS1 Categories, Proofs and Processes — MT (half unit)
- CCS3 Quantum Computer Science — HT (half unit)
- CCS4 Automata, Logics and Games — HT (half unit)

Other Non-Mathematical Units and Half Units

PHILOSOPHY

- Rise of Modern Logic — MT (whole unit)

DISSERTATION

- OD Dissertations on a Mathematically related Topic — half unit or whole unit

Language Classes: French

3.5 Exit points

We hope, and expect, that you will enjoy studying Mathematics at Oxford and will successfully complete your degree. A high proportion of those admitted to read Mathematics elect to stay for 4 years to complete the MMath; of the remainder, almost all obtain the B.A. in Mathematics after 3 years. A very few students will opt to switch to another Oxford course or, exceptionally, to a course at another university.

3.5.1 Three years or four years?

The choice of which degree you take will be based on your interests and aptitudes, your performance in the first two years and your career intentions. You should discuss your decision with your college tutors, who will be able to advise you on which course is more appropriate for you. To proceed to Part C you must obtain second class honours or higher in Parts A and B together.

By default, all students are registered for the MMath. If you subsequently decide to take the B.A. option you must inform your college office who will in turn inform the central administration and the departments. You will be asked in Michaelmas Term of your third year in an e-mail from the Academic Office in the Mathematical Institute to confirm whether or not you intend to stay for the fourth year. You will be asked for a reply giving your decision by Friday of week 8 in MT. The decision you declare at this point is not immutable, but should be final if at all possible, and you are strongly advised to take a final decision before the start of your Part B examinations. There are circumstances in which you cannot be certain of your intentions by the end of MT, for example, you might be considering the MMath but also be submitting applications for jobs or graduate courses to which the outcome is not yet known.

Please ensure that you have consulted your college tutor(s) before making your decision. It is critically important that your college knows your intentions as early as possible in order to plan for the following year. The Mathematical Institute will notify your college of your decision, but in many colleges this will not happen soon enough if the allocation of accommodation to continuing students takes place before the end of MT. You are therefore requested to notify your college, either yourself or through your tutor, of your intentions, and to keep the college fully informed if these subsequently change.

It could happen that, having embarked upon your fourth year, you are for whatever reason unable to complete the Part C course, or decide that you do not wish to do so. In these circumstances you are advised to discuss your situation with your college's Senior Tutor at the earliest opportunity.

3.5.2 Changing course

We very much hope, and in the great majority of cases can confidently expect, that you will do well in this course and will feel you are benefiting from your studies. At the same time, you should not feel that your original choice is irrevocable if it is not turning out as you had anticipated. In any degree course a very few who embark upon it may come to feel it is not the right course for them. Mathematics is no exception, and a few students doing the course change to another (also a few doing some other course change to Maths).

If you are feeling you should change, the first thing is to be patient for a while. You may be finding the course difficult, but all courses that are worth doing are difficult at times, and your tutors are there to help you with difficulties. Seek their advice, and maybe discuss

your problems with your contemporaries: you are not in competition with them, and you should get into the habit of helping and being helped. Nevertheless you may continue to feel that the course is not right for you.

If you are considering changing from Mathematics to another Oxford course, the possibilities are to change to a course joint with Mathematics, or to an entirely different course. This last is the most radical and feasibility depends on particular interests, background and circumstances. The first is more generally feasible. You will find it helpful to talk to fellow students studying the course or courses to which you might like to change and to consult the University Prospectus and course documentation available on the web. Normally your college will have admitted you to read for a specific undergraduate degree (consisting of the sequence of First Public Examination followed by Final Honour School). If you wish to explore the possibility of changing course, first talk to one of your current tutors or, if that is embarrassing, to the Senior Tutor or to someone else in your college with responsibility for academic welfare of students. After that, talk to tutors in the subject to which you wish to change.

If you have already made a substantial start on your course then it is likely that your tutors will advise you to stay with it until you have completed your First Public Examination. By proceeding in this way you may be able to change course without losing a year, since you must pass a First Public Examination in some course or other before you can proceed to any Final Honour School and any First Public Examination counts as a qualification for any Final Honour School. (The only undergraduates eligible for exemption from the requirement to pass a First Public Examination before entering for an Honour School are those who have already obtained a degree at another university.)

Changing to another course joint with Mathematics

If you are considering changing to a Mathematics joint course before Mods, then you need to be aware that you will need to catch up on course work in the other subject. To change to a joint Mathematics course after Mods will involve studying over the summer some of the material examined in the other subject. Your tutors will advise you what to concentrate on.

Changing to another Oxford course: the formalities

If you decide you do want to change course, there are three bodies that must approve: your college, the University, and those who are paying for you. Permission from your college will be needed for change to another course. This is liable to be refused if the receiving tutors think you unsuited to their course, or don't have room. The University is unlikely to be a problem. It accepts for any examination all candidates who are suitably qualified and supported by their colleges. However, a few departments, such as Psychology, do have quotas for acceptance on to the courses taught in them.

See below as regards financial issues in connection with a change of course.

Moving to another university

The most radical (and rare) change is to decide to study at another university, either because the course you realise you want to do isn't offered by Oxford, or because you feel that you will do better somewhere else. Before deciding to pursue such a step be sure to get lots of advice, both from tutors and from family and friends. If in the end it seems a good idea,

you should be able to ask your college to support your application for a place at another university.

3.5.3 Financial issues

Please be aware that any change to your choice of degree may impact on your level of maintenance funding and the time taken to receive your student loan (you are advised to contact Student Finance,
`http://www.direct.gov.uk/en/EducationAndLearning/UniversityAndHigherEducation/StudentFinance` for further enquiries).

If you have financial support for your studies from an award, scholarship, or sponsorship, this is likely to be on the basis of the specific course you are pursuing, in which case permission from your funding body to change course, even within Oxford, will be required if this support is to continue. You will need to ask your Senior Tutor to write to your funding body to certify that you have been given permission to change course.

The MMath is recognized as a masters-level qualification. For students not classified as Overseas, there may be adverse financial consequences in taking the MMath (rather than the B.A.) if they wish thereafter to take another masters-level Taught Course. This arises because of ELQ (Equivalent or Lower Qualifications) fee liabilities: universities do not receive any government funding for ELQ students and consequently adopt a special ELQ fees rate, which is likely to be roughly double that of the standard fee for graduate taught courses. Information can be found at `http://www.admin.ox.ac.uk/studentfunding/fees/feerates/elq.shtml` .

3.6 The Long Vacation

3.6.1 International Summer Exchanges

The Mathematical, Physical and Life Sciences Division have set up international summer exchanges with Princeton University and the California Institute of Technology. This would operate as a student exchange: a student from the Mathematical Institute would take the place of an American student, who in turn would come to Oxford.

Any student who is interested in such a summer exchange, to take place in summer 2011, would need to have the outline of a project that would be completed at the overseas institution. This work would not be formally assessed, but if in the following term, the student wished to register for an extended essay or dissertation on a similar or related topic, then this vacation work could form the background work for an assessed piece of written work.

Project outlines should be submitted to the Chairman of the Mathematics Teaching Committee by week 2 of Trinity Term 2011. Every effort will be made to find supervisors and exchange partners at both institutions. Students would need to be self-financing, although we are looking at support from Rhodes House.

3.6.2 Summer Projects

1. EPSRC vacation bursaries
   The Engineering and Physical Sciences Research Council scheme started in the summer of 2006. In 2007 the MPLS Division received 10 studentships and 15 in 2008 and 2009. Attached to each student award was a weekly stipend of approximately £180

payable for ten weeks to enable students to conduct a project that would not normally be part of the undergraduate programme. Topics related to the Roberts's shortage areas (this includes Maths, Stats and OR) were specifically targeted. The emphasis is for undergraduates to receive first-hand positive and practical experience of research.

2. Wellcome Trust Bursaries
   Further information is available at
   http://www.wellcome.ac.uk/Funding/index.htm

3. Nuffield Science bursaries
   Further information is available at
   http://www.nuffieldfoundation.org/go/grants/nsbur/page_412.html

4. BBSRC vacation bursaries
   The Biotechnology and Biological Sciences Research Council also fund vacation awards, for projects in Mathematical Biology.
   http://www.bbsrc.ac.uk/funding/studentships/research-experience-placements.aspx

5. News International Placement Scheme
   The News International Benefaction includes a scheme which allows some students to have a short period of work experience with newspapers in the News International Group. Further information is available at
   http://www.english.ox.ac.uk/news-and-events/prizes-and-studentships.html

Project titles vary from year to year. For examples of vacation project titles please see https://www.maths.ox.ac.uk/current-students/undergraduates/projects.

4 Teaching and Learning

4.1 Lectures and how to get the best out of them

All official lectures are advertised in the termly **lecture list** for Mathematical Sciences. Students can download the lecture list from the websites `http://www.maths.ox.ac.uk/notices/lecture-lists` and `http://www.admin.ox.ac.uk/pubs/lectures`. In addition, each week's timetable with details of lecture rooms is posted on the electronic notice board in the Mathematical Institute. All Mathematics lectures for first years will be held in the University Museum Lecture Theatre.

Lectures are usually timetabled to last an hour but there is a convention for undergraduate lectures to commence a few minutes after the hour and finish 5 minutes before the hour to allow for students to move in and out of the room. For the first three years, students will attend 8-10 hours of lectures a week and 5-6 in the fourth year, on average.

Lectures are a traditional way of presenting material at university level. They demand a mature, disciplined, highly motivated audience. For mathematics, they are a particularly important, intense and effective way of conveying information. Think of a course of lectures as learning to find your way around a new town, e.g., Oxford. For most people the most effective way to familiarise themselves is to have a guided tour by someone who already knows the main features and how to get to them. A tour might be quite fast and miss some things out so that you need to go again relatively soon afterwards to see if you can find the way yourself. So it is with lectures. You will not gain a complete understanding without further work yourself. But without lectures it is hard to get started and very hard to gain a full understanding. The lecturer knows the important facts and theorems and can lead you along a path which includes the background necessary to understand and appreciate the results as they unfold. Most mathematicians find it easier to learn from lectures than books.

A lecturer presents mathematics as a growing thing and so you learn mathematics by watching an expert actually doing it. But to really understand the material you will need to go through each lecture soon after it has been delivered and certainly before the next lecture in a series. You will also need to test and reinforce your knowledge by doing problems requiring you to apply your knowledge. To tackle the set problems, first you need to recognise which material in the lectures is relevant and then maybe put it together in a way which is close to, but not the same as, that given in lectures. It is by reflecting on the material in lectures, also reading about it explained in a slightly different way in textbooks, that you will internalise the material and make it our own. You will know when you have understood it sufficiently because then you are able to explain it to others, give a mini-lecture.

As a student and a member of the audience you have obligations. Arrive on time. (Enter very discreetly if you are late.) Don't bring in food or drink (unless required by special medical condition). Turn off your mobile phone. Don't chatter with your friends, either about the material in the lectures or social matters. (To do so is inconsiderate of the other members of the audience and the lecturer. It is a serious distraction both for the lecturer and other members of the audience. To give a lecture requires considerable concentration on the part of the lecturer and after a distraction it can be difficult to to pick up the thread and continue.) Participate in the lecture by giving it your full attention. Try not to let your mind wander. Try to follow the arguments as you write them down. If you are very tired or lose the thread, then persist with the notes so you can go over them

afterwards and be ready for the next lecture. But there are a few occasions when it is good to interrupt a lecture. This is when the lecturer makes a minor slip or 'typo', for example, writes + when it should be − or α when it should be β. It is then helpful if an alert member of the audience quickly asks for clarification so that everyone can make the correction in their notes. Don't leave it too long or the lecture will be seriously disrupted.

You will find that some lecturers produce lecture notes which are posted online but it is strongly recommended that you take your own notes. With practice, notetaking becomes semi-automatic and is a valuable transferable skill to acquire. Notetaking is an aid to concentration, keeping your mind from wandering during the lecture. Most people find it easiest to revise from their own hand written notes. So try to write neatly during the lectures or rewrite immediately after the lecture so you have a fair copy; number the pages; leave wide margins for adding comments or references to other useful sources; and file everything in order (lectures notes, tutorial notes, copies of problem sheets, your marked solutions to problems, notes you have made from textbooks). Get to grips with each lecture before the next. If you find yourself getting lost, go back through your lecture notes, ask your tutor for clarification on parts you can't follow and ask other students or the lecturer if you think you might have copied down something incorrectly. The lecturer is not obliged to produce online notes in time for you to do the problem sheets set for tutorials. You should certainly not miss lectures if notes are available. The lectures will no doubt contain many comments not in the notes, comments which bring the material alive and help you understand and remember.

A student with a disability or special needs which affects his or her ability to take notes of lectures should contact the Disabilities Service, college tutor and the Academic Administrator at the Mathematical Institute. See also the departmental Disability Statement at Appendix G

4.2 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 intercollegiate 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, useful for revision.

4.3 Tutorials

To support lectures in the 1st and 2nd years, colleges arrange tutorials and classes for their students. How these are organised will vary from college to college and subject to subject. For example, in your first and second years you might have two (one-hour) tutorials each week, with between one and three other students. You will be set some work for each tutorial and in the tutorial you will discuss the work and 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, and even if you have not been able to solve every problem. It is also a

good idea before going to the tutorial to make a note of anything you want to ask.

4.4 Classes

Each 16-hour lecture half unit in the subjects of Part B will be supported by classes run under the Intercollegiate Class Scheme. Students generally attend four $1\frac{1}{2}$ classes for each Part B half unit. Most Part C half units will be supported by classes, though some may be run as reading courses. Students usually attend seven 1 hour classes for each Part C half unit.

Each class will usually consist of between five and twelve students from a number of different colleges and is run by a class tutor and a teaching assistant. Occasionally some students change options during the first weeks resulting in larger classes; but students and their tutors will be advised where this happens. The course lecturer provides suitable **problem sheets**, and also provides specimen solutions for 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 are discussed in detail, and there is an opportunity to ask the class tutor and teaching assistant about 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. Consultation sessions to help with revision are run in Trinity term though some colleges also run classes to help with pre-examination revision. College tutors will explain their own arrangements.

4.5 Practicals

For some of the units there is a component of compulsory practical work. Arrangements 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.

4.6 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.

Written questionnaires are handed out by each lecturer, who will give time during a lecture for its completion. 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 to consider this information is the *Joint Consultative Committee for Undergraduates*,(JCCU) 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.

We have some formal channels of communication with you. When the Director of Undergraduate Studies or the Department wishes to consult you about policies or inform you of action taken following requests from the JCCU, you will be advised via e-mail to look at the JCCU website. Minutes of the JCCU meetings taken by your student representatives, reports and feedback on student requests can also be found here. See `http://www.maths.ox.ac.uk/current-students/undergraduates/jccu`.

4.7 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 yours.

4.8 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 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)
E M Fellmann, *Leonhard Euler*, Birkhäuser (2007)
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)
J Stedall, *Mathematics Emerging: A Sourcebook 1540 – 1900* (OUP, 2008).

5 Resources

5.1 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. **Reading lists** are issued alongside the **lecture synopses** and are revised annually. They contain a range of suggestions, including alternatives and suggestions for further reading.

To make best use of a book, it is best to have your own copy so think seriously of buying 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 Blackwell's second-hand department but they sell out rapidly. Amazon also sells second-hand books.

5.2 Libraries

The main source of borrowed books is your **College Library**. College libraries generally purchase the books which appear in the **reading lists** for every Mods, Part A and Part B course, and many Part C courses. In practice, college libraries also provide a good selection of the books listed as 'further reading', and, indeed, a wider selection of background and alternative reading, some of which have gone out of print.

Many college libraries have a number of copies of key books and are usually responsive to requests for new purchases, but *they need to be asked*. The colleges have various mechanisms for these requests; again your college tutor will be able to advise you.

The other source of books to borrow is the **Radcliffe Science Library** in Parks Road. This library is associated with the **Bodleian** and as an undergraduate you are entitled to use it. When you arrive in Oxford you will be given a combined reader's card/University Card which you should carry with you. This will give you access to any part of the **Bodleian Library** and any of its dependent libraries.

5.3 IT

The University is committed to making available computer facilities sufficient to cover the course-work requirements of junior members.

All students will be automatically allocated a University email 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 college students' rooms are wired with ethernet points to enable students to connect their own PCs to the network. There is a concern for computer security and anyone opening an account must agree to abide by the University's rules. At Oxford there is a University disciplinary procedure for enforcing the rules, and breaches of them will involve the Proctors with all the sanctions and penalties available to them.

Some University webpages are NOT available from outside the Oxford network. But 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/undergrads`

5.4 Other

5.4.1 Computing Services

Your computing requirements will be supported primarily by the departmental and college 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/`

5.4.2 The Language Centre

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

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.lang.ox.ac.uk/`

There may be an opportunity for students who have studied some French or German 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.

5.4.3 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. The Careers Service also provides training in writing applications, interview techniques and analysis of transferable skills. The Careers Service provides information about occupations and employers, and advertises work experience opportunities.

Members of the Faculty who have taught you are usually willing to provide support and references. The Careers 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 Careers Service runs an annual 'Jobs for Mathematicians' half-day, in collaboration with the Mathematical Institute. At this event there are talks from alumni currently working in jobs suitable for mathematicians. The

event also helps students consider their transferable skills. You can find more information at http://www.careers.ox.ac.uk.

The Mathematics Undergraduate Representation Committee (MURC) has set up an emailing list for careers and studentship information, to which you could sign up to. 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.

5.4.4 University Lectures

University **lectures** in all subjects are open to all students. A consolidated **lecture list** is available on the University website at:
http://www.admin.ox.ac.uk/pubs/lectures/.

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.

5.4.5 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 Prof. Batty's "How do Undergraduates do Mathematics?" available in paper copy from reception in the Mathematical Institute, and electronically on the website http://www.maths.ox.ac.uk/files/study-guide/index.shtml. The *Projects Committee* gives guidance on the choice and preparation of extended essays and dissertations.

5.4.6 Special Needs

Specialised advice and assistance is available for dyslexic, blind/partially sighted, and other disabled students from the University Disability Office
http://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, in Appendix G.

6 Organisation and Representation

6.1 Mathematical, Physical & Life Sciences Division

The Mathematics courses are overseen by the Mathematical, Physical & Life Sciences Division. Your departments have the responsibility to deliver the courses.

6.2 The Departments

Academic staff teaching undergraduate mathematics belong to one of three departments: the Mathematical Institute, the Department of Statistics, and the Computing Laboratory. These departments provide most of the rooms and resources for the courses.

The Mathematical 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 lecture theatre in the University Museum.) The MuPAD course demonstration sessions are held in the Statistics Department computing laboratories. Problem sheets may be downloaded from the department's website also some lecture notes, additionally copies of some lecture notes are sold at the Reception desk. 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.)

6.3 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.

6.4 Colleges

Oxford University is a collegiate university. All undergraduates are members both of a college and the university. Courses, syllabuses, lectures and examinations are organised and delivered by the university. Colleges are responsible for making undergraduate admissions to the university. They deliver tutorial and class teaching, and are generally responsible for the academic and personal well-being of their students.

In a college there will be one or more subject tutors to select students, deliver tutorial and class teaching and generally guide students through their studies. Usually at the beginning and end of each term, a student will meet their subject tutor to discuss selection of options and to make and receive information on teaching arrangements, etc. Students will also be assigned personal tutors to whom they may turn for general advice. The personal tutor may be in the same subject as the student or another subject altogether. Colleges have other welfare officers to whom students may turn for advice. Students will be advised at the beginning of their studies how things work in their individual colleges.

Colleges vary in their provision of accommodation, sports and music facilities, clubs, library books, book grants, computing facilities, teaching, induction and study skill sessions, etc.

6.5 Invariants Society

The Oxford University Invariant Society, with website `http://users.ox.ac.uk/~invar/` is the undergraduate mathematical society. Its primary aim is to host weekly talks by notable speakers, on a wide variety of mathematical subjects. The Invariants also host social events, a Christmas party and an annual formal dinner. Titles of talks previously given include: Mathematics, Magic and Electric Guitars; Juggling: theory and practice; Bells and Change Ringing. There are opportunities for members to give their own talks. Meetings are held on Tuesdays at 8.00 pm at the Mathematical Institute. Anyone interested should come to the first meeting (which is free) to find out more.

6.6 Representation

6.6.1 MURC

The Mathematics Undergraduate Representative Committee (informally known as MURC) is composed of students who represent the interests of mathematics, computer science and statistics students. It consists of a representative from each 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 courses. It is important for colleges to have 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 considers matters relating to the synopses and proposed changes of syllabus.

The membership of the Joint Consultative Committee is twelve members of MURC appointed by MURC and representatives of the Department of Mathematics, of Computation and of Statistics. The committee is usually chaired by the Director of Undergraduate Studies and 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 may attend meetings of the Faculty of Mathematics, and the Chairperson may attend meetings of the Mathematics Teaching Committee.

6.6.2 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.

6.6.3 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.

6.6.4 College

Most colleges have procedures set in place for consultation, monitoring, and feedback.

6.6.5 The Proctors and Academic Appeals

In the rare case of any student wishing to make an appeal against an examination result, the appeal is made on their behalf by the college to the Proctors. Students should also be aware that they have the right to take certain other matters directly to the Proctors (see 8.1). Contact details can be found in Appendix C.

7 Assessment and Examinations

As well as a medium of instruction, the tutorial is a personally tailored form of continuous assessment, and both you and your tutor should have a very good idea of how your studies are progressing. College tutors will also organise college examinations, called **collections**, from time to time, usually at the start of term; these are not to be confused with the University's **public** examinations which qualify you for your degree.

For the undergraduate degrees in Mathematics you will sit examinations each year in Trinity Term, called **public examinations** because they are organised by the University, rather than privately by your college.

7.1 Preparation

Your tutor will advise you about revision and practice. As well as any consolidation work done after the end of term, it is usual to spend much of Trinity Term revising work for the coming examinations.

In subjects which were taught in previous years, past examination papers are a good guide to the sort of examination question that might be set. These can be found on the web at `http://www.maths.ox.ac.uk/current-students/undergraduates/examinations/past-papers`

Please note that the syllabus for the examination may have changed, and is certainly not determined by what appeared in past papers. Your tutor will be able to give you advice on relevant questions.

7.2 Entering for University Examinations

In years 1 and 2 examination entry becomes automatic when you register at the beginning of the year. Your college will ask you to register through the self-service *link* where you confirm all your personal details.

For each student a personal timetable will be issued and sent to the college a few weeks before the examination. This gives details of where and when each of the written papers for which you are entered will take place. Your college will pass on your timetable together with a randomly allocated **candidate number** which you will use to identify your scripts, instead of your name and college. You must take your candidate number to every examination you sit.

Before the examinations you will receive at least one **notice to candidates** from the examiners to give you the details of the examination procedure.

7.3 Procedure for Written Examinations

First and second year examinations are held at **Ewert House** in Summertown; third and fourth year examinations in the **Examination Schools** on the High Street. When attending public examinations you must wear full academic dress (subfusc and gown) and carry your cap. You must bring your University Card with you.

Allow plenty of time to reach the examination room. Desks will be identified by your name and college, and arranged in alphabetical order of names. You **will need to know your candidate number** so that you can write it (and *not* your name) on your answer booklet. The question paper will be on your desk when you go into the examination. You should check that it is the paper for which you have entered, and read carefully the instructions on the cover. You may not open it until told to do so.

You will be provided with answer booklets of A4 paper in which to write your answers. You must write in ink, rather than pencil, though you may use pencil for any graphs and diagrams. Please answer questions following the instructions given on the front of the exam paper; these will include commencing each question in a new answer booklet and crossing out any rough working.

7.4 First Public Examination

At the end of the third term of the first year, both the three- and four-year courses have the same first year University examination, Honour Moderations in Mathematics. 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 and 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 MuPAD projects. The Moderators give **Advice to Candidates** on marking conventions and how they identify and reward excellence; see Appendix F which contains an extract from our examination conventions for more information.

7.4.1 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%
2007	31%	57%	6%	4%	3%
2008	37%	57%	3%	0%	3%
2009	30%	59%	4%	1%	6%
2010	29.9%	61.27%	5.4%	0%	3.4%

7.4.2 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. It consists of two papers taken in the following September.

7.5 Second Public Examination

7.5.1 Part A

The three- and four-year courses have the same University examinations Mathematics Part A, taken at the end of the third term of the second year. Part A is not classified, but the results will be carried forward to the classification awarded at the end of the third year (see below). The four Part A papers should be completed before taking the Part B. Any deviation requires the approval of the Education Committee of the University.

7.5.2 Part B

At the end of the third term of your third year you will take Part B. 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 four whole units. The Examiners give **Advice to Candidates** on marking conventions, etc.

On the basis of your performance in the Parts A and B examinations 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%
2007	35.88%	46.47%	14.71%	2.35%	0.59%	0%
2008	34.19%	47.74%	14.19%	3.23%	0.65%	0%
2009	36.09 %	44.97%	13.61 %	2.96%	1.78%	0.59%
2010	35.71%	34.61%	18.18%	5.84%	0%	0.65%

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

7.5.3 Part C

If you take the MMath course, the second and third year will be very similar to the BA and you will take Parts A, B and C with Part C at the end of your fourth year . **Examination Regulations** and amendments published in the University Gazette will give full details. You will receive a class at the end of Part B (as above) and a separate class for Part C. 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%
2007	45.8%	42.2%	10.8%	2.4%	0%	0%
2008	46.32%	47.37%	6.32%	0%	0%	0%
2009	50.53%	31.28%	13.68%	3.16%	0%	1.05
2010	46.23%	34.91%	14.15%	4.72%	0%	0%

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

7.5.4 Examination Results

The Examiners will provide you with a University Standardised Mark for each paper. You will be able to access your results via Student Self Service. The Academic and Assessment Results page within Student Self Service gives details of all your assessment results (examination papers and/or submissions) and the overall result for the year (if applicable).

7.5.5 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 infrequently used procedures.

7.6 Projects, Dissertations, Extended Essays

Third year students may write an extended essay or structured project each 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, expounding it clearly and persuasively, and using citations. Some students show their abilities better on a sustained piece of exposition rather than on solving problems set in a three-hour examination paper.

Note the most up to date account of penalties regarding late submission of project work (found in `http://www.admin.ox.ac.uk/examregs/08-16_Part_16_Marking_and_assessment.shtml`.).

Dissertation and extended essays must be submitted to the Chairman of Examiners c/o the Examination School, High Street, Oxford by the deadline published in the synopses. You will also need to complete a declaration of authorship form.

Dissertations and extended essays will be assigned USMs according to the same principles as Mathematics papers. In arriving at these marks, the relative weights (for BE Essays and Dissertations) given to content, mathematics, and presentation will be 25%, 50% and 25%, respectively. These will not apply for OE Essays and OD Dissertations on historical

or similar topics. However, the content should none the less, have substantial connections with mathematics. Here is a brief explanation of these terms:

Content: the examiners are looking for some of your own thoughts and contributions: you must do more than rehash text books and lecture notes; you should use original sources; you must not plagiarise.

Mathematics: proofs and assertions should be correct, and the mathematics should be appropriate for the level of study. In applied topics, the derivation of the model should be properly justified.

Presentation: the mathematics must be clear and well laid out; the English should be clear and grammatically correct; sources should be properly acknowledged, references should be properly cited. Give some thought to notation, choice of typeface, and numbering of equations and sections. Do not fail to number the pages. Be sure to supply complete and accurate references for all the sources used in completing the project, and be sure to cite them properly in the text.

Supervision : you would normally expect to have up to 8 hours supervision over two terms for a whole unit dissertation or extended essay, and 4 hours for a half unit dissertation.

Excellent brief advice on mathematical writing is to be found on the London Mathematical Society website `http://www.lms.ac.uk/publications/documents/writing.pdf`

All projects are independently blind double-marked. The examiners oversee the reconciliation of the two marks in consultation with the assessors.

Students are invited to give an informal presentation of their work to their supervisor before the end of Hilary Term. Although not formally assessed, this provides useful feedback to the student and is part of the learning process.

Further details are given in the project guidelines which are available online at `http://www.maths.ox.ac.uk/current-students/undergraduates/projects.`

7.7 Examination Regulations

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

7.8 Prizes

The following prizes are available for undergraduate students. These are awarded by the Examiners, and no application is necessary.

Moderations

- Two IBM prizes of 250 each, are available for performance in Mathematics papers for candidates in Honour Moderations.

Part B

- Gibbs Prizes of £400 and a proxime accessit prize of £200 or two equal prizes of £300 at the discretion of the Examiners.
- Gibbs Mathematics Prize of £100 for Mathematics and Philosophy candidates.
- 2 Junior Mathematical prizes of £200 each.

- IMA Prize of a year's free membership.

Part C

- A single Gibbs Prize of £400 or two equal Gibbs Prizes of £200, at the discretion of the examiners.
- Gibbs Mathematics Prize of £100 for Mathematics and Philosophy candidates.
- Junior Mathematical Prize of £200.
- IMA Prize of a year's free membership.

8 University Regulations and Codes

8.1 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 consultations 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 (which means that they play a major part in seeing that University examinations are conducted properly and fairly, and in enforcing disciplinary regulations);
- investigating complaints by members of the University (the Proctors have the power to summon any member of the University before them to help in their enquiries);
- serving on a wide range of University committees (to assure themselves that the University's procedures are working satisfactorily).

8.2 Paperwork

The Proctors and Assessor have produced a booklet called **Essential Information for Students** which you will be given by your college. This contains general information about health and welfare matters; the Student Union; residence; sport and recreation; intellectual property; safety and security. It is 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.

8.2.1 Regulations for Candidates in University Examinations

Students should refer to the **Examination Regulations** for the full regulations regarding examinations. For example, Parts 9 - 18, and 20 relates to the conduct of examinations and Part 19 gives the *Proctorial's Disciplinary Regulation for Candidates in Examination.*

As stated 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 Academic Registrar and Secretary of Faculties or approved by the Proctors as a place for one or more candidates to take an examination.

It is a student's responsibility to be aware of University guidance of these matters.

8.3 Plagiarism

The University and Department employ 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.

Below is the University definition of what constitutes Plagiarism. All cases would be regraded as a serious disciplinary matter and could result in your being suspended or being sent down.

8.3.1 What is plagiarism?

Plagiarism is the copying or paraphrasing of other peoples work or ideas into your own work without full acknowledgement. All published and unpublished material, whether in manuscript, printed or electronic form, is covered under this definition.

Collusion is another form of plagiarism involving the unauthorised collaboration of students (or others) in a piece of work.

Cases of suspected plagiarism in assessed work are investigated under the disciplinary regulations concerning conduct in examinations. Intentional or reckless plagiarism may incur severe penalties, including failure of your degree or expulsion from the university.

8.3.2 Why does plagiarism matter?

It would be wrong to describe plagiarism as only a minor form of cheating, or as merely a matter of academic etiquette. On the contrary, it is important to understand that plagiarism is a breach of academic integrity. It is a principle of intellectual honesty that all members of the academic community should acknowledge their debt to originators of the ideas, words, and data which are included in a piece of work. Passing off anothers work as your own is not only poor scholarship but also means that you have failed to complete the learning process. Deliberate plagiarism is unethical and can have serious consequences for your future career. It also undermines the standards of your institution and of the degrees it issues.

8.3.3 What forms can plagiarism take?

- **Verbatim quotation** of other peoples intellectual work without clear acknowledgement. Quotations must always be identified as such by the use of either quotation marks or indentation, with adequate citation. It must always be apparent to the reader which parts are your own independent work and where you have drawn on someone elses ideas and language.

- **Paraphrasing** the work of others by altering a few words and changing their order, or by closely following the structure of their argument, is plagiarism because you are deriving your words and ideas from their work without giving due acknowledgement. Even if you include a reference to the original author in your own text you are still creating a misleading impression that the paraphrased wording is entirely your own. It is better to write a brief summary of the authors overall argument in your own

words than to paraphrase particular sections of his or her writing. This will ensure you have a genuine grasp of the argument and will avoid the difficulty of paraphrasing without plagiarising. You must also properly attribute all material you derive from lectures.

- **Cutting and pasting from the Internet**. Information derived from the Internet must be adequately referenced and included in the bibliography. It is important to evaluate carefully all material found on the Internet, as it is less likely to have been through the same process of scholarly peer review as published sources.

- **Collusion**. This can involve unauthorised collaboration between students, failure to attribute assistance received, or failure to follow precisely regulations on group work projects. It is your responsibility to ensure that you are entirely clear about the extent of collaboration permitted, and which parts of the work must be your own.

- **Inaccurate citation**. It is important to cite correctly, according to the conventions of your discipline. Additionally, you should not include anything in a footnote or bibliography that you have not actually consulted. If you cannot gain access to a primary source you must make it clear in your citation that your knowledge of the work has been derived from a secondary text (e.g. Bradshaw, D. Title of Book, discussed in Wilson, E., Title of Book (London, 2004), p. 189).

- **Failure to acknowledge**. You must clearly acknowledge all assistance which has contributed to the production of your work, such as advice from fellow students, laboratory technicians, and other external sources. This need not apply to the assistance provided by your tutor or supervisor, nor to ordinary proofreading, but it is necessary to acknowledge other guidance which leads to substantive changes of content or approach.

- **Professional agencies**. You should neither make use of professional agencies in the production of your work nor submit material which has been written for you. It is vital to your intellectual training and development that you should undertake the research process unaided.

- **Autoplagiarism**. You must not submit work for assessment which you have already submitted (partially or in full) to fulfil the requirements of another degree course or examination.

8.3.4 Not just printed text!

The necessity to reference applies not only to text but also to other media, such as computer code, illustrations, graphs etc. It applies equally to published text drawn from books and journals, and to unpublished text, whether from lecture handouts, theses or other students essays. You must also attribute text or other resources downloaded from web sites.

All matters relating to plagiarism are taken very seriously and any breach will lead to a disciplinary matter.

See for example, The Proctors and Assessor booklet **Essential Information for Students** Section 9, also available on-line at `http://www.admin.ox.ac.uk/proctors/info/pam/section9.shtml`

8.4 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.

8.5 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.

8.6 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.

8.6.1 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. All colleges select students for admission without regard to marital status, race, gender, 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.

8.6.2 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.

8.6.3 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.

8.6.4 Staff Development and Training

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

8.6.5 Complaints

A candidate for admission who considers that he or she has not been treated in accordance with this equal opportunities 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.

8.7 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, presently 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 in the emergency exit procedure which is displayed in the Mathematical Institute. In the case of evacuation of the lecture theatre give heed to the instructions of the lecturer.

9 Information for International Students

This is aimed at International students but in fact may be helpful to all students.

9.1 Contacts

International Students Advisory Service (tel:(2)70105)
Examination Schools, High Street, Oxford
email: `international.office@admin.ox.ac.uk`, website: `www.admin.ox.ac.uk/io`

Oxford University Language Centre (tel:(2)83360)
email: `admin@lang.ox.ac.uk`, website: `www.lang.ox.ac.uk`

Oxford University Student Union - International Students Officer
email: `international@ousu.org`

9.2 Language Skills

It is important, for many international students, to continue to develop English language skills, both for academic studies in Oxford and future careers. Some students, at the beginning of their time in Oxford, find they need to translate academic material into their first language before it can be digested. Some even go so far as to read translations of recommended texts. Students should aim to reach the point where they can think about their subject and solve problems directly in English, without any translation. Students are encouraged to discuss their work, even work together with other students, and we recommend that such joint work is conducted in English.

Undergraduates may attend one of the courses organised by The Oxford University Language Centre and also use their library of independent learning materials. More generally, the mastery of English will improve with constant reading and social interaction in English.

9.3 Working with other students

Students are encouraged to discuss their academic work with others but, to derive most benefit and really master the material, no student should simply copy another student's work. We recommend a student first to make his or her own attempt and identify any difficulties before asking for help or working with other students. Then after any work with others and finding a proof or solution, a student should write out his or her own version, without a copy of any other student's work open on the desk. This way the material will become internalised and absorbed. Any student needing constant help from other students should recognise they need extra help and seek advice from college or class tutors. Tutors are there to help you learn and prefer students to consult them before any lack of academic progress becomes serious. We have an English saying: 'A stitch in time saves nine.'

9.4 Examinations

Examinations in Oxford are conducted very formally. Students must wear subfusc. They must write in ink, only using pencils for diagrams. They may not bring into the examination room any materials which may help with the answers to questions. For Mathematics examinations students will be asked to provide formal definitions and proofs as

well as solve problems. Some material needs to be committed to memory and it is very difficult to recall and reproduce it appropriately if there is little understanding. During your preparation for any examination you should aim to **understand** the material on the syllabus. Then recalling proofs and definitions will come naturally and with little effort. Many students find that answering questions from past papers is an effective and interesting way to revise. These questions can be accessed at `http://www.maths.ox.ac.uk/current-students/undergraduates/examinations/past-papers`

Part I
Appendices

A 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.

Programme outcomes with Teaching, Learning and Assessment Strategies

By the end of this degree programme, students will have attained the following "Outcomes", that is, they will have developed knowledge and understanding of the following.

Part I. Specialised Mathematical Knowledge	
1. The core areas of mathematics including the principal areas of mathematics needed in applications.	In the first four terms of the programme there are lectures on algebra, analysis, differential equations, probability, and mathematical methods, supported by college-based tutorials.
2. Some of the principal areas of application of mathematics.	In the first year there are lectures on dynamics, probability, statistics, and mathematical models, supported by college-based tutorials; together with further options later in the course.
3. The correct use of mathematical language and formalism in mathematical thinking and logical processes.	Example in lectures in the first two years, practice in weekly problem sheets, with critical feedback by college tutors, tutorial discussion, printed and electronic notes of guidance.
4. The basic ideas of mathematical modelling.	Lectures on mathematical models in the first year, supported by practice in work for college tutorials, together with further options later in the course.
5. Some of the processes and pitfalls of mathematical approximation.	Examples on problem sheets and MuPAD in first year.
6.Techniques of manipulation and computer-aided numerical calculation.	Practice in work for college tutorials and MuPAD practical work in the first year.
7. The basic ideas of a variety of pure and applied areas of specialisation.	A choice of lecture courses, supported by college tutorials or small classes in the second part of the second year.
8. Several specialised areas of mathematics or its applications, the principal results in these areas, how they relate to real-world problems and to problems within mathematics (including, in the four-year course, problems at the frontiers of current research).	Lectures in the third year and fourth years delivered by lecturers actively engaged in research, together with supporting problem classes conducted by subject specialists.

Assessment strategies Formative assessment (feedback is given but marks do not necessarily count towards your classification) on a weekly basis by marking of tutorial and class work, and on a termly basis by college collections (college examinations at the beginning of term) or assessed vacation assignments. Summative assessment (with a final mark which

is used in your classification) by four three-hour written papers at the end of year one, assessment of two computer projects in year one, by two three-hour 'breadth papers' in year two designed to test, through bookwork and unseen problems, breadth of understanding across the whole syllabus for the year; and two three-hour 'depth papers', designed to test understanding in depth through further questions on bookwork and more substantial unseen problems. In years three and four, summative assessment is by a combination of one and a half- or three-hour subject papers on bookwork and unseen problems (the usual form of assessment in year three), extended essays, dissertations, practical work, projects, and mini-projects.

Students will have the opportunity to develop the following skills during the course

Part II. Intellectual skills
1. The ability to demonstrate knowledge of key mathematical concepts and topics, both explicitly and by applying them to the solution of problems.
2. The ability to comprehend problems, abstract the essentials of problems and formulate them mathematically and in symbolic form so as to facilitate their analysis and solution.
3. Grasp how mathematical processes may be applied to problems including, where appropriate, an understanding that this might give only a partial solution.
4. The ability to select and apply appropriate mathematical processes.
5. The ability to construct and develop logical mathematical arguments with clear identification of assumptions and conclusions.
6. The ability to use computational and more general IT facilities as an aid to mathematical processes and for acquiring any further information that is needed and available.
7. The ability to present mathematical arguments and conclusions from them with clarity and accuracy, in forms suitable for the audiences being addressed.
8. Students who have focussed on pure mathematics will have skills relating particularly to rigorous argument and solving problems in generality, and facility with abstraction including the logical development of formal theories and the relationships between them.
9. Students who have focussed on physical applied mathematics will have skills relating particularly to formulating physical theories in mathematical terms, solving the resulting equations analytically or numerically, and giving physical interpretations of the solutions.

Teaching and learning opportunities and assessment strategies These skills are acquired through lectures, classes, tutorials, practical classes, studying recommended textbooks and through work done for projects, extended essays and dissertations and oral presentations.

They are assessed formatively during tutorials and classes and summatively in the examination processes each year.

Part III. Mathematics related practical skills	Teaching and Learning opportunities
1. Calculating fluently and accurately in abstract notation.	Practised throughout the course in problem work for tutorials and classes.
2. Use of mathematics computer packages	Lectures, MuPAD practical classes and informal practice sessions supported by demonstrators in the first year; use of MuPAD and other packages where appropriate in problems and lectures in later years (e.g. Matlab).

Assessment strategies The first element is assessed summatively (with a final mark) in the examination processes each year and the second element is assessed summatively (with a final mark) in the MuPAD projects in the first year and practical work undertaken in later years in for example Statistics, Mathematical Physics and Computer Science. Formatively (feedback is given but marks do not necessarily count towards your classification) during tutorials, classes and in college collections.

Part IV. General skills	Teaching and Learning opportunities
1. To analyse and solve problems, and to reason logically and creatively.	Weekly mathematical problem sheets with tutorial or class support, often requiring significant development of ideas beyond material found in lectures and books.
2. Effective communication and presentation orally.	Weekly tutorial and class assignments; requirement to defend written work in tutorials, and presentation of solutions in classes. Summer Essays. Extended Essays and Dissertations. Presentation of project work.
3. The ability to learn independently.	A learning process that requires students to put together material from a number of sources, including lectures, tutorials, text- books, and electronic sources, largely in their own time.
4. Independent time management.	Requirement to produce substantial amounts of written work against strict tutorial and class deadlines; necessity to balance academic and non-academic activities without continuous oversight.
5. To think critically about solutions and to defend an intellectual position.	Discussion and criticism in tutorials.
6. Collaboration	Tutorial groups are encouraged by the tutorial system to work together, to share ideas and to develop the practice of crediting others for their contributions.
7. Use of information technology.	Compulsory practical work; extensive use of the network for distributing teaching materials and for communication.
8. Language skills.	The opportunity is available in the third year to study a foreign language.

Assessment strategies The tutorial system provides formative assessment of elements (1-5). There is summative assessment of element (2) in the yearly examinations and of element (7) in the assessment of first-year computer projects and second- and third-year practicals. The language option does not contribute to final class, but successful completion

will be recorded on student transcripts.

Further information about the programme outcomes and the teaching, learning and assessment strategies may be found in the programme specification. This is available online at `http://www.maths.ox.ac.uk/teaching-staff/programme-specifications`

B The Joint Courses

B.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.

B.2 Mathematics & Computer Science

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.

For more details about this course please see the separate handbook and Computing Laboratory website (`http://web.comlab.ox.ac.uk/`).

B.3 Computer Science

There is a separate handbook for this course, and information can be found on the Computing Laboratory website (`http://web.comlab.ox.ac.uk/`).

B.4 Mathematics & Philosophy

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.

For more details about this course please see the separate handbook available at `http://www.maths.ox.ac.uk/current-students/undergraduates/handbooks-synopses/mathsphil`.

C Contact Points

C.1 Mathematical Institute

Director of Undergraduate Studies Director of Undergraduate Studies
email: director-ugrad-studies@maths.ox.ac.uk

Faculty Chairman Professor Charles Batty (tel: (2)77375)
email: charles.batty@sjc.ox.ac.uk

Academic Administrator Mrs Charlotte Turner-Smith (tel: (6)15203)
email: turner-smith@maths.ox.ac.uk

Deputy Academic Adminstrator Mrs Helen Lowe (tel: (6)15204)
email: loweh@maths.ox.ac.uk

Graduate Studies Assistant Mrs Margaret Sloper (tel:(6)15206)
email: sloper@maths.ox.ac.uk

Academic Assistant Miss Sandy Patel (tel:(6)15208)
email: patels@maths.ox.ac.uk

Academic Assistant Ms Amelia Bliss (tel:(6)15205)
email: bliss@maths.ox.ac.uk

C.2 Faculty of Statistics

Chairman of Academic Committee Dr Neil Laws (tel: (2)72875)
email: laws@stats.ox.ac.uk

Academic Administrator Ms Jan Boylan (tel: (2)72860)
email: boylan@stats.ox.ac.uk

C.3 Faculty of Computer Science

Chairman of Teaching Committee Prof. Peter Jeavons (tel: (2)73853)
email: Peter.Jeavons@comlab.ox.ac.uk

Academic Administrator Dr Shoshannah Holdom (tel: (2)73863)
email: Shoshannah.Holdom@comlab.ox.ac.uk

C.4 Projects Committee

Chairman Prof Roger Heath-Brown
email: rhb@maths.ox.ac.uk

C.5 Careers Service

Enquiries (tel: (2)74646)

Mathematics Link Mr Cherag Kalapesi (tel: (2)74654)
email: cherag.kalapesi@careers.ox.ac.uk

C.6 MURC

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

Chairperson Mr Henry Bradford, St John's College
email: henry.bradford@sjc.ox.ac.uk

C.7 Invariants

General
webpage: http://www.invariants.org.uk

President Ms Rosie Cretney, Queen's College
email: president@invariants.org.uk

C.8 General

Disabilities Office (tel: (2)89840)
email: disability@admin.ox.ac.uk

Counselling Service (tel: (2)70300)

Proctors' Office (tel: (2)70090)
email: proctors.office@proctors.ox.ac.uk

Equal Opportunities Officer (tel: (2)89821)
email: equal.opportunities@admin.ox.ac.uk

Accessible Resources Acquisition and Creation Unit (tel: (2)83861)
email: ruth.harris@ouls.ox.ac.uk

Oxford University Student Union, Vice President (Welfare) (tel: (2)88450)
email: welfare@ousu.org

D 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.

E Academic Staff

The following hold **Statutory Chairs** :

- Sedleian chair of Natural Philosophy held by **Prof. Sir J M Ball FRS**;
- Whitehead Professorship of Pure Mathematics held by **Prof. Martin R Bridson**;
- Rouse Ball chair held by **Prof. P Candelas**;
- Professorship in the Analysis of Partial Differential Equations held by **Prof. G-Q Chen**;
- Professorship of Mathematics and Applications held by **Prof. S J Chapman**;
- Charles Simonyi Professor for the Public Understanding of Science held by **Prof. M du Sautoy**;
- Professorship of Mathematical Modelling held by **Prof. A Goriely**;
- Chair of Pure Mathematics held by **Prof. R Heath-Brown FRS**;
- Savilian Professorship held by **Prof. N J Hitchin FRS**;
- Wallis Professorship held by **Prof. T J Lyons FRS**;
- Professorship of Mathematical Biology held by **Prof. P K Maini**;
- Waynflete Professorship of Pure Mathematics held by **Prof. R A Rouquier**;
- Professorship of Numerical Analysis held by **Prof. L N Trefethen FRS**;
- Man Professorship of Quantitative Finance held by **Prof. T Zariphopoulou**;
- Professorship of Mathematical Finance held by **Prof. X Zhou**;
- Professorship of Mathematical Logic held by **Prof. B Zilber**.

A number of members of the Institute are Fellows of the Royal Society. These include Professor Sir J Ball, Professor B Birch, Professor I P Grant, Professor R Heath-Brown, Professor N Hitchin, Professor F Kirwan, Professor I James, Professor T J Lyons, Professor J R Ockendon, Professor R Penrose, Professor G Segal, Professor U Tillman.

Many faculty are regularly recognised for the quality and significance of their research and are duly awarded prizes. Here are some of the prizes and awards that Faculty have been awarded in the last few months alone:

- **Royal Society Prizes and Medals** Professor Sir John Ball was awarded the Royal Society's Sylvester Medal for his seminal work in mechanics and nonlinear analysis and his encouragement of mathematical research in developing countries. Professor Marcus du Sautoy won the Michael Faraday Prize in recognition of his excellent work in science communication.

- **London Mathematical Society prizes** The Plya Prize was awarded to Professor Roger Heath-Brown for his many contributions within analytic number theory, and his dynamic application of analytic methods in wide-ranging investigations. The Naylor Prize and Lectureship in Applied Mathematics was awarded to Professor Philip Maini in recognition of his contributions to, and influence on, the field of mathematical biology. A Whitehead Prize was awarded to Dr Cornelia Druţu her work in geometric group theory.

- **French Academy of Sciences** awarded Professor Raphaël Rouquier the Elie Cartan Prize.

- **The Society for Industrial and Applied Mathematics** honoured Professor John Ockendon, Professor Nick Trefethen and Dr Nick Gould who have made outstanding contributions to fields served by SIAM.

- **Mothers in Science** the Royal Society recently published the personal time lines of 64 senior ranking female scientists working in Science, Technology, Engineering and Mathematics (STEM). Three Oxford Mathematicians featured were Professor Frances Kirwan, Professor Ulrike Tillmann and Professor Alison Etheridge.

- **The Adams Prize 2009** Professor Raphaël Rouquier was awarded the prize for this year year's topic on Representation Theory, for the quality, depth and influence of his work which is already highly impressive. The prize is awarded by the Faculty of Mathematics and St John's College Cambridge to a young UK-based researcher doing first class international research in the Mathematical Sciences.

The full list of news on the department may be found at `http://www.maths.ox.ac.uk/news`

We also award **Excellence in Teaching Awards** and in 2010 honoured

- Dr A. Dancer, Dr R. Earl, Dr J. Obloj, Mr P Trinh and Dr C Reisinger with an individual teaching award.

In addition to those in established posts there are about 24 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 (`http://www.comlab.ox.ac.uk/people/`), Statistics Department (`http://www.stats.ox.ac.uk/people`) and Philosophy Centre (`http://www.philosophy.ox.ac.uk/the_faculty`).

Faculty of Mathematics Details can be found on the web about members of the Faculty of Mathematics
`http://www.maths.ox.ac.uk/ldapcontact/statusrange#PermanentFaculty&Emeritus`

F Examination Conventions

The formal procedures determining the conduct of examinations are established and enforced by the University Proctors. For the Mathematical Institute examination conventions are set out in this course handbook and in additional supplements. These conventions are a guide to the examiners and candidates but the regulations set out in the Examination Regulations have precedence. The examiners are nominated by the Nominating Committee in the Mathematical Institute and those nominations are submitted for approval by the Vice-Chancellor and the Proctors. Formally, examiners are independent of the Department and of those who lecture courses. However, for written papers in Mathematics, examiners are expected to consult with course lecturers in the process of setting questions.

The paragraphs below give an indication of the conventions to which the examiners usually adhere, subject to the guidance of the appointed external examiners, and other bodies such as the Teaching Committee in the Mathematical Institute, the Mathematical, Physical and Life Sciences Division, the Education Committee and the Proctors who may offer advice or make recommendations to examiners. It must be stressed that to preserve the independence of the examiners, candidates are not allowed to make contact directly about matters relating to the content or marking of papers. Any communication must be via the Senior Tutor of your college, who will, if he or she deems the matter of importance, contact the Proctors. The Proctors in turn communicate with the Chairman of Examiners.

F.1 Moderations

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 MuPAD projects.

The first two papers are also taken by candidates in *Mathematics & Philosophy*. Each paper has eight questions and candidates may submit answers to at most 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 format of Papers Applied Mathematics I and Applied Mathematics II changed slightly in 2007/08 (this was to enable Maths & Computer Science candidates to answer questions on probability).

The paper **Applied Mathematics I** is divided into two sections: (i) Calculus of one variable and dynamics, and (ii) Calculus of two or more variables and probability. There will be four questions 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.

The paper **Applied Mathematics II**, as in previous years, contains questions on Fourier Series and 2 variable calculus, PDEs, calculus of 3 variables but will also contain a question on statistics.

Marks for each individual examination will be reported as university standardised marks (USM).

The object of the USM is to allow direct comparison between the results of examination in different subjects. This means that the USM will not correspond to the raw mark. In the case of mathematics the conversion tends to exaggerate small differences at the top and at the bottom of the scale. It is usually true that USM conversion makes the performance of a weak candidate appear better than the raw marks would suggest. It is often, but not always true that the effect is reversed for strong candidates.

A USM of 70+ indicates 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 MuPAD 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 Class: $Av_1 \geq 70$ and $Av_2 \geq 70$

Second Class: Not satisfying the conditions for a first class and both $Av_1 \geq 50$ and $Av_2 \geq 50$

Third Class: Not satisfying the conditions for a second class and both $Av_1 \geq 40$ and $Av_2 \geq 40$

Pass: Not satisfying the conditions for a third class and $Av_2 \geq 30$

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 each paper.

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.

Qualitative description of examination performance for the various classes for each paper

First Class: the candidate shows excellent skills in reasoning, deductive logic and problem-solving. He/she demonstrates an excellent knowledge of the material, and is able to use that in unfamiliar contexts.

Upper Second Class: the candidate shows good or very good skills in reasoning, deductive logic and problem-solving. He/she demonstrates a good or very good knowledge of much of the material.

Lower Second Class: the candidate shows adequate basic skills in reasoning, deductive logic and problem-solving. He/she demonstrates a sound knowledge of much of the material.

Third Class: the candidate shows reasonable understanding of at least part of the basic material and some skills in reasoning, deductive logic and problem-solving.

Pass: the candidate shows some limited grasp of at least part of the basic material.

[Note that the aggregation rules in some circumstances allow a stronger performance on some papers to 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.

Advice from Examiners

The following is typical of recent letters of Advice to Candidates, called "Notices 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. **C**alculators 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 cover sheet.
- 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.

The use of dictionaries in mathematics examinations is no longer permitted.

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 cover sheet, 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. 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.

F.2 Late Submission of or Failure to Submit Coursework

The Examination Regulations stipulate specific dates for submission of the required pieces of coursework to the Examiners (this includes History of Mathematics coursework, Mathematics Education Undergraduate Ambassadors Scheme coursework, Extended essays, Structured Projects and Dissertations). Rules governing late submission and any consequent penalties are set out in the 'Late Submission of Work' sub-section of the 'Regulations for the Conduct of University Examinations' section of the Examination Regulations 2009 on page 46.

Late submission of coursework for Mathematics examinations will normally result in the following penalties:

- With permission from the Proctors under clause (2) of para 16.8, page 45, no penalty.
- With permission from the Proctors under clauses (3) + (4) of para 16.8, a penalty of a reduction in the mark for the coursework in question of at least 5 USMs (or at least 5% of the maximum mark available for the piece of work); the exact penalty to be set by the Examiners with due consideration to the advice given in the document 'Academic Penalties for Late Submission of a Thesis or Other Exercise: Proctors Notes for Guidance', dated 1/11/06.
- Where the candidate is not permitted by the Proctors to remain in the examination he or she will be deemed to have failed the examination as a whole.
- Where no work is submitted or it is proffered so late that it would be impractical to accept it for assessment the Proctors may, under their general authority, and after (i) making due enquiries into the circumstances and (ii) consultation with the Chairman of the Examiners, permit the candidate to remain in the examination. In this case the Examiners will award a mark of zero for the piece of coursework in question.

F.3 Finals

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 Fail performance (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

This section may change for examinations for Part A in 2011.
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 attempts to as many questions as they wish. The best four questions will count for the total mark for this paper, with at least one question from each section. That is, the best question from each section together with the next best question will be counted for your total mark on 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 as many questions as they wish, 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 as many questions as they wish, 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:

- 20-25 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.

- 13-19 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.

Examinations for whole unit papers are of **three hours duration** and half unit papers are of **one and a half hour duration**. The rubrics are given below.

There are three questions in each half unit. For a whole unit paper the rubric states "candidates may submit answers to as many questions as they wish: the best two from each section will count". For a half unit paper the rubric states "candidates may submit answers to as many questions as they wish: the best two will count".

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 aim to ensure that all papers are fairly and equally rewarded and may take into account relative difficulty of papers when assigning USMs. The Examiners may recalibrate the raw marks to arrive at the USMs reported to candidates. In arriving at any recalibration, the examiners will principally take into account the total sum of the marks for all questions on a paper, subject to the rules above on numbers of questions answered.
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 whole 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 papers taken in Part C and may recalibrate the raw marks to arrive at university standardised marks reported to candidates. 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.
For the MMath in Mathematics one of the classifications will be based on Part C alone.

Aggregation of marks for award of Part B

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).

We use a *Strong Paper rule* for classification.

Strong Paper rule
A candidate will have satisfied the First Class, resp., Upper Second Class, resp., Lower Second Class strong paper rule if at least 3 papers from Parts A and B lie in that class (or better) and include at least one of them in Part B.

To give an example, a candidate will have satisfied the Upper Second Class strong paper rule if (the equivalent of) at least 3 of their whole unit paper USMs have at least Upper Second Class marks with (the equivalent of) at least one Upper Second Class whole unit at Part B level. Students may take half unit papers for Part B and for two half units (not making up a whole unit paper) to count as the equivalent of a whole unit of at least Upper Second Class, both half units must be of at least Upper Second Class.

The Strong Paper rule gives a *marks profile.*

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

In the following $Av\ USM = Average\ weighted\ USM\ for\ Parts\ A\ and\ B\ together$ (rounded up to whole number);

- First Class: $Av\ USM \geq 70$ and the First Class strong paper rule satisfied.
- Upper Second Class: $Av\ USM \geq 70$ and the First Class strong paper rule not satisfied **OR** $70 > Av\ USM \geq 60$ and the Upper Second class strong paper rule satisfied.
- Lower Second Class: $70 > Av\ USM \geq 60$ and the Upper Second Class strong paper rule not satisfied **OR** $60 > Av\ USM \geq 50$ and the Lower Second Class strong paper rule satisfied.
- Third Class: $50 > Av\ USM \geq 40$ **OR** $60 > Av\ USM \geq 50$ and the Lower Second Class strong paper rule not satisfied
- Pass: $40 > Av\ USM \geq 30$
- Fail: $Av\ USM < 30$

BA in Mathematics
Any candidate who satisfes the Examiners for Parts A and B (and who does not subsequently enter for and achieve Honours for Part C) may supplicate for the Honours degree of the Bachelor of Arts in Mathematics with the classification as described above, provided that they have fullfilled all the conditions for admission to a degree of the university.

MMath in Mathematics
In order to proceed to Part C, a candidate must minimally achieve lower second standard 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).

Let $AvUSM - PartC = Average\ USM\ in\ Part\ C$ (rounded up to a whole number)
Classes are determined as follows in conjunction with the qualitative class descriptors.

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

A 'Pass' will not be awarded for Year 4. Candidates achieving:

$$AvUSM - PartC < 40,$$

may supplicate for a BA with the classification obtained at the end of Part B.

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

Candidates leaving after four years who satisfy the Examiners may supplicate for an MMath in Mathematics, with two associated classifications; for example:
MMath in Mathematics: Years 2 and 3 together - First class; Year 4 - First class.

Note that successful candidates may supplicate for one degree only - either a BA or an MMath. The MMath has two classifications associated with it, but a candidate will not be awarded a BA degree and an MMath degree.

Qualitative Class Descriptors

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

- First Class: the candidate shows excellent skills in reasoning, deductive logic and problem-solving. He/she demonstrates an excellent knowledge of the material, and is able to use that in unfamiliar contexts.
- Upper Second Class: the candidate shows good or very good skills in reasoning, deductive logic and problem-solving. He/she demonstrates a good or very good knowledge of much of the material.
- Lower Second Class: the candidate shows adequate basic skills in reasoning, deductive logic and problem-solving. He/she demonstrates a sound knowledge of much of the material.
- Third Class: the candidate shows reasonable understanding of at least part of the basic material and some skills in reasoning, deductive logic and problem-solving.
- Pass: the candidate shows some limited grasp of at least part of the basic material. [Note that the aggregation rules in some circumstances allow a stronger performance on some papers to 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.

Advice from Examiners

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

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 615203, email academic.administrator@maths.ox.ac.uk] at the earliest possible opportunity.

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

The Academic Administrator 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. Within the faculty/department the officer concerned will attempt to resolve your concern/complaint informally and as speedily as possible.

Students may also contact their student representatives for informal support on MURC and the Joint Consultative Committee for Undergraduates.

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.

In the rare instances where you are dissatisfied with the outcome of a complaint, and all other avenues listed above have been explored, 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.

Further information can be obtained from the Proctors Memorandum.

I Questionnaires

On the next page is a specimen of the Questionnaires used to monitor the effectiveness of the teaching. The system is described above in Section 3.6. 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.

MURC/SUB-FACULTY LECTURE QUESTIONNAIRE

TITLE OF LECTURE COURSE……
NAME OF LECTURER……
YEAR……
COURSE……

Q1. Did you attend most of the lectures for this course? 1.YES / 2.NO
If no, why not?……

(Please circle numbers)	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Q2. The lectures were interesting	5	4	3	2	1
Q3. The lectures were well structured	5	4	3	2	1
Q4. The lecturer explained the material well	5	4	3	2	1
Q5. I could obtain good notes either in the lectures or from online sources	5	4	3	2	1
Q6. The lecturer used visual aids (boards/OHP) effectively	5	4	3	2	1
Q7. The lecturer was clearly audible	5	4	3	2	1
Q8. The lecturer did enough worked examples	5	4	3	2	1
Q9. The course built on my existing knowledge	5	4	3	2	1
Q10. I found the course worthwhile	5	4	3	2	1

Q11. The problem sheets (where used) were:
1. much too hard / 2. too hard / 3. about right / 4. too easy / 5. much too easy
(circle as appropriate)

Q12. The pace of the course was:
1. much too fast / 2. too fast / 3. about right / 4. too slow / 5. much too slow
(circle as appropriate)

Q13. Was your college able to arrange satisfactory tutorials or classes in support of these lectures? [Mods and Part a courses only]
1. Yes / 2. No
(circle as appropriate)

[The purpose of this question is to determine the adequacy of tutorial provision in this area as a whole. If you have particular concerns about the tutorial provision in your college you may wish to contact the Director of Undergraduate Studies at subfaculty-chairman@maths.ox.ac.uk . This is in addition to the normal procedures in colleges, via your senior Tutor etc.]

Q14. Where course materials were available from the web were you able to download them readily?
1. Yes / 2. No
(circle as appropriate)

You are invited to provide in the space overleaf constructive comments that could help to improve the quality of teaching. You may supply further comments by emailing them to director-ugrad-studies@maths.ox.ac.uk. These will be entered (without your name) on a database and the complete responses given to the lecturer.

The administrative staff will not process any form containing inappropriate material.

J Policy on Intellectual Property Rights

The University of Oxford has 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* 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 B. Intellectual Property

(1) The University claims ownership of all intellectual property specified in section 6 of this statute which is devised, made, or created:

  (a) by persons employed by the University in the course of their employment;

  (b) by student members in the course of or incidentally to their studies;

  (c) by other persons engaged in study or research in the University who, as a condition of their being granted access to the University's premises or facilities, have agreed in writing that this Part shall apply to them; and

  (d) by persons engaged by the University under contracts for services during the course of or incidentally to that engagement.

(2) The University's rights under sub-section (1) above in relation to any particular piece of intellectual property may be waived or modified by agreement in writing with the person concerned.

6. The intellectual property of which ownership is claimed under section 5 (1) of this statute comprises:

(1) works generated by computer hardware or software owned or operated by the University;

(2) works created with the aid of university facilities including (by way of example only) films, videos, photographs, multimedia works, typographic arrangements, and field and laboratory notebooks;

(3) patentable and non-patentable inventions;

(4) registered and unregistered designs, plant varieties, and topographies;

(5) university-commissioned works not within (1), (2), (3), or (4);

(6) databases, computer software, firmware, courseware, and related material not within (1), (2), (3), (4), or (5), but only if they may reasonably be considered to possess commercial potential; and

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

7. The University will not assert any claim to the ownership of copyright in:

(1) artistic works not listed in sub-section (2) of section 6 of this statute, books, articles, plays, lyrics, scores, or lectures, apart from those specifically commissioned by the University;

(2) audio or visual aids to the giving of lectures;

(3) student theses, exercises and answers to tests and examinations save to the extent that they contain intellectual property claimed by the University under subsection (6) of section 6 of this statute; or

(4) computer-related works other than those specified in section 6 of this statute.

8. For the purpose of sections 6 and 7 of this statute, 'commissioned works' are works which the University has specifically employed or requested the person concerned to produce, whether in return for special payment or not, but, save as may be separately agreed between the University Press and the person concerned, works commissioned by the University Press in the course of its publishing business shall not be regarded as 'works commissioned by the University'.

9. Council may make regulations:

(1) defining the classes of persons or naming individuals to whom section 5 (1) (c) of this statute shall apply;

(2) requiring student members and such other persons as may be specified in regulations to sign any documents necessary in order to give effect to the claim made by the University in this Part and to waive any rights in respect of the subject-matter of the claim which may be conferred on them by Chapter IV of Part 1 of the Copyright, Designs and Patents Act 1988; and

(3) generally for the purposes of this Part.

10. This Part shall apply to all intellectual property devised, made, or created on or after 1 October 2000 and is subject to the provisions of the Patents Act 1977.