

PHYSICS Master of Physics (MPhys) and BA Programme Specifications

1. Awarding institution/body	University of Oxford
2. Teaching institution	University of Oxford
3. Programme accredited by	Institute of Physics
4. Final award	MPhys (four-year) or BA (three-year)
5. Programme	Physics
6. UCAS code	F303 (MPhys) or F300 (BA)
7. Relevant subject benchmark statement	Physics & Astronomy, QAA 2008
8. Date of programme specification	September 2009

9. Educational aims of the programme

- To provide a course of the highest academic quality in physics in a challenging but supportive learning environment that attracts the very best students from the UK and elsewhere.
- To provide students with a systematic knowledge of core physics based on a firm experimental and theoretical foundation, together with elective elements informed by the forefront of the discipline.
- To develop transferable skills related to problem solving, critical evaluation of primary data, and communication. In addition to acquire practical techniques and computing skills.
- To bring students to a position on graduation that allows them to choose confidently from many different careers, whether within physics or not, and enables them to contribute rapidly to their chosen employment.
- In addition those completing the four-year MPhys will
 - cover in depth two areas of contemporary physics, with critical discussion of aspects of current research
 - have completed a substantial open-ended project requiring advanced practical or theoretical techniques, frequently inspiring some originality
 - be well placed to start graduate study for a research degree at a leading university either in the UK or overseas or pursue a research related career in a physics-based industry.

10. Programme outcomes

A. Students will develop a knowledge and understanding of:

- the general theoretical and experimental principles and techniques of physics
- a broad range of physics topics on all scales from the sub-atomic to the whole cosmos
- relevant mathematical techniques and how they are applied to physical problems
- sound experimental procedures, including data recording and analysis and how to write up an experiment

- basic electronics, computer programming and numerical methods as applied to physics

In addition those taking the MPhys will know

- two areas of physics, taken as 4th year options, to the advancing edge of the subjects
- how to plan, execute and write up a challenging, open ended project, often within a research group

Related teaching/learning methods and strategies

- Lectures provide the systematic exposition of material in all four years of the course
- Classes (small groups of up to 10 students) are used to discuss and expound problem sets related to the material in the lectures
- Tutorials (usually in pairs) are used to discuss the more difficult concepts, stretch the most able students and provide focused help for those having difficulty
- Practicals (usually in pairs) enable students to develop experimental skills and to attempt some of the key experiments on which the subject is based

Private study, particularly during the vacations is both necessary and expected, as it provides opportunities for consolidation and for reading beyond and around the syllabus

Assessment

Public (university) examinations are taken at the end of the summer term of each year of the course.

The Preliminary Examination in Physics is a pass/fail examination covering the foundation topics of the first year in physics and mathematics. It must be passed (a resit is allowed in September) to proceed further on either of the three- or four-year courses. The marks do not count towards the degree classification.

The Final Examination for the four-year Honour School in Physics is taken in three Parts, A, B, C contributing 25, 35 and 40% respectively to the final MPhys degree classification. Part A, taken at the end of year 2, is common to both the three- and four-year courses and it must be passed at a minimum of a II(i) standard to proceed to the last two years of the four-year course.

The Final Examination for the three-year Honour School in Physics leading to the BA is in two parts: Part A (common to both courses) is taken at the end of year 2; Part B (BA) is taken at the end of the 3rd year. The two Parts, A, B, contribute 40% and 60%, respectively, of the total marks for the BA.

Formative assessments are carried out within the college context through tutorials, classes and termly examinations (collections).

B. Skills and other attributes

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

I. Intellectual skills

- Appreciation of the unity of the underlying principles of physics
- Ability to assimilate and relate a wide range of physical phenomena and facts using these fundamental principles
- Ability to apply appropriate mathematical or numerical techniques to model physical phenomena
- Ability to solve a range of known problems and tackle unseen and more open ended ones

- Ability to collate, analyse and interpret complex experimental information and infer conclusions
- Ability to conduct a logical discussion
- Ability to précis physical arguments and facts and give succinct oral and written presentations, using IT based methods where appropriate

Teaching/learning methods and strategies

The first four are acquired through lectures, classes, tutorials and self study, the remainder through tutorials, practical sessions in the teaching laboratories and project work in the 3rd or 4th years.

Assessment

The first four are assessed through written examinations, written class and tutorial assignments; the fifth through assessed practical work; the sixth through tutorial discussions and the last through public presentations and the project report.

II. Practical skills (where relevant)

- Aware of the need for safety in the practical laboratories with due reference to the risks of ionising radiation, lasers, cryogenics, compressed and flammable gases, electronic and electrical equipment
- Ability to carry out accurate measurements using a range of physical techniques and data acquisition systems
- Ability to execute and write up a short open ended project within a limited period (BA)
- Ability to plan, execute and write up an open ended project (MPhys)

Teaching/learning methods and strategies

These skills are taught through the teaching laboratories and project work.

Assessment

The first two are assessed through the marking and discussion of individual experiments by demonstrators in the teaching laboratories. A practical component in the 2nd and 3rd year contributes to the classification of the degree. The final year project is assessed by a combination of a report from the supervisor and the examiners assessment of the project report. The 4th year students meet with a projects assessment committee and there is an oral component for the assessment of the written report.

III. Transferable skills

- Problem solving in a variety of contexts, and the ability to relate problems to first principles
- The ability to devise and manipulate mathematical and numerical models
- Time management and organisational ability for practical tasks
- The ability to study for research or other professional qualifications.
- The ability to communicate effectively both in writing and orally
- Familiarity with IT for document production and information retrieval
- Foreign Language ability (optional for those who wish to maintain or improve a language)

Teaching/learning methods and strategies

The first four skills are acquired through lectures, tutorials and classes; the fifth through tutorials and writing up practicals; the sixth largely through the 3rd or 4th year projects. Foreign language tuition is

option taken in the 2nd or 3rd year and is taught by the University Language Teaching Centre, using classes and lectures.

Assessment:

The first two are assessed by a combination of unseen written examinations and specific practicals in the computer teaching laboratory; the third, fourth and fifth through the 4th year project and assessed short talks. The foreign language ability is assessed on the basis of tests at the beginning and end of the course.

11. Programme Structures and Features

- A four year course leading to the degree of Master of Physics with honours or a three year course leading to the BA(Hons). The first two years are common to both courses.
- The first year covers foundation material in physics and mathematics and an introduction to practical work. The Preliminary Examination in Physics (First Public Examination) is taken at the end of the year (with a resit in September) and must be passed to continue on the course. A small number of students may change to cognate disciplines, such as Materials Science or Earth Sciences, at this point.
- The Honour School leading to the MPhys covers the remaining three years and is examined in three parts (A, B, C) at the end of each year.
- The BA(Hons) course takes two years with exams (Parts A & B) taken at the ends of years two and three.
- The 2nd year (Part A) covers the fundamental principles of physics, with associated laboratory work and Short Options. Part A is also the qualifying test to proceed to the final years of the MPhys.
- The 3rd year (MPhys, Part B) covers a wide range of physical phenomena on all scales from the sub-atomic to the whole cosmos, with associated laboratory work and Short Options.
- The 3rd year (BA, Part B) covers a choice of two subject areas from those offered for the MPhys Part B, associated laboratory work and a short project undertaken in the final term.
- In the 4th year (MPhys, Part C) students take two Major Options from a choice of seven provided by the Physics Department and some from other departments and undertake an open ended project.
- Short Options are taken during years one to three and are intended to provide challenges either on topics outside the mainstream of the course or on specific areas (particularly mathematical or theoretical) in greater depth. Some laboratory work may be substituted by additional Short Options and this path is particularly suited for students intending to pursue graduate studies in theoretical physics. The list of Short Options will vary from year to year.

Learning:

Year 1

Subjects

CP1: Physics 1

CP2: Physics 2

CP3: Mathematical Methods 1

CP4: Mathematical Methods 2

Short Options: e.g. Quantum Ideas, Functions of a Complex Variable, From Planets to the Cosmos

Introduction to practical work

Assessment (Preliminary Examination in Physics)

The four written papers on CP1-4, each of 2.5 hours, must be passed (pass mark 40%) in one examination. Students failing up to two papers may retake these in September. Failure on more than two papers requires all four to be taken again. Practical work is assessed on the basis of a record of successful completion of '15 days' work. Failure to reach the required number may result in sanctions such as the inability to be awarded a distinction. One Short Option is examined in a 1.5 hour written paper. The examiners may award a distinction to those who show special merit across all the tests and have passed papers CP1-4 at one sitting.

Year 2

Subjects (Fundamental Principles of Physics)

A1: Thermal Physics (Kinetic Theory, Thermodynamics, Statistical Mechanics)

A2: Electromagnetism and Optics

A3: Quantum Physics

Mathematical Methods

Short Options: e.g. Classical Mechanics, Energy Studies, Medical & Environmental Physics, Language Option

Assessed Practical Work

Assessment (FHS Part A, both MPhys & BA)

Three three-hour written papers are taken at the end of the summer term on subjects A1-A3. The mathematical methods underpin the material in all three papers. The practical assessment is based on experiments ('12 days' and an assessed practical) and an oral skills exercise. One Short Option is examined in a 1.5 hour written paper.

To proceed to the final two years of the MPhys course, Part A must be passed at a minimum level of an upper second class honours. If this not achieved, the student transfers to the three-year BA course. The marks from Part A contribute approximately 25% of the final MPhys degree total and approximately 40% of the BA total.

Year 3

Subjects (Physics)

B1: Atomic Structure, Special Relativity and sub-Atomic Physics

B2: Condensed Matter Physics and Photonics

B3: Astrophysics and Atmospheric Physics

B4: Mathematical Physics*

Short Options: e.g. Energy Studies, Plasma Physics, Medical and Environmental Physics

Assessed Practical Work

*by application only

Assessment (FHS Part B, MPhys)

Three three-hour written papers are taken at the end of the summer term on subjects B1-B4. The practical assessment is based on experiments ('12 days' and an assessed practical) and a written skills exercise. One Short Option is examined in a 1.5 hour written paper.

The marks from Part B contribute approximately 35% of the MPhys degree total.

Assessment (FHS Part B, BA)

Two three-hour written papers, chosen from the list B1-B4, are taken at the end of the summer term. The practical assessment is based on experiments ('6 days' plus an assessed practical) and written skills exercises. A short project assessed on the basis of a written report. One Short Option is examined in a 1.5 hour written paper. The marks from Part B contribute approximately 60% of the BA degree total.

Year 4

Subjects (Major Options)

C1: Astrophysics

C2: Laser Science and Quantum Information Processing

C3: Condensed Matter Physics

C4: Particle Physics

C5: Physics of Atmospheres and Oceans

C6: Theoretical Physics

C7: Biological Physics

C8: 'External Options' e.g. some papers in mathematics (provided by the Mathematical Institute) Project

Assessment (FHS Part C, MPhys)

Two three-hour written papers are taken at the end of the summer term, one on each of two subjects from the above list. The project is undertaken during the Hilary Term of the 4th year and written up for submission to the examiners at the start of Trinity Term. Each of the three components contributes roughly equally to the marks for Part C and the total contributes approximately 40% of the marks for the MPhys degree classification.

12. Support for Students and their learning

- All undergraduates reading Physics have a college tutor responsible for their academic welfare. This person will also hold a university teaching post in the Physics Department. In addition to college tutors, college Deans provide more general welfare support and liaise with the University Counselling Service. Most colleges are able to house most of their undergraduates throughout the course and provide social and sports facilities.
- During the first three years of the Physics courses, college tutors are responsible for organising the tutorial and class teaching that complements and exercises the material covered in lectures.
- In the 4th (final) year of the MPhys course, classes in the Major Option subjects are organised by the Department and, where possible, given by members of the permanent teaching staff. College Tutors are informed on a termly basis of their students' progress (more frequently if problems arise).
- All colleges have good library provision and at university level, the Hooke library provides a lending service for science subjects. College Libraries are a major resource for subjects at undergraduate level. Undergraduates are also entitled to make use of the Radcliffe Science Library (non-lending research library).
- Students have access to computers in college and in the teaching laboratories. Most college rooms have internet access.

Information about the courses is provided in the Undergraduate Course Handbook (distributed at the start of each year to all Physics undergraduates in residence) and more information and links to physics sites worldwide are provided by the Physics Department website (www.physics.ox.ac.uk).

13. Criteria for Admission

- The normal expectation is A/L grade A's in Physics, Mathematics (single subject) and one other subject (or equivalent for those taking Scottish qualifications, Baccalaureates, Abitur etc).
- As Physics is a large subject (around 180 students admitted each year), interviews are conducted in colleges. All applicants must take two tests; one in Mathematics and one in Physics before they are invited for interview. Submitted work is not required. A meeting of all those involved in college interviewing is held to agree the short list of applicants to be invited for interview based on the outcome of the two tests. Reallocation that is reassigning applicants from more popular to less popular colleges has been practised by Physics for some time. All short listed applicants are interviewed by two colleges. Another meeting is held during the admissions process to ensure that the best qualified candidates are offered places, independently of college of first choice.
- Candidates are assessed against the following criteria:
 - Motivation: a real interest and strong desire to learn physics.
 - Ability to express physical ideas using mathematics; mathematical ability.
 - Reasoning ability: ability to analyse and solve problems using logical and critical approaches.
 - Physical intuition: an ability to see how one part of a physical system connects to another and to predict what will happen in a given physical situation.
 - Communication: ability to give precise explanations both orally and numerically.

14. Methods for evaluating and improving the quality and standards of learning

Responsibility for the course is vested in the Department of Physics, which is part of the Mathematical Physical and Life Sciences Division. The Divisional Board has formal responsibility for the maintenance of educational quality and standards in the broad subject areas, and exercises its responsibility through its Academic Committee, and in particular the scrutiny it gives to new course proposals and proposed course revisions, to reports of examiners, and to more general questions of academic policy.

- The quality of the course is monitored on a regular basis by the Physics Teaching Faculty (essentially all staff involved in teaching in any capacity) and the Academic Committee (charged by the Chairman of the Department and the Physics Management Committee with the responsibility for providing the undergraduate courses). Input to these bodies comes from
 - Internal Examiners' reports
 - External Examiners' reports
 - Physics Joint Consultative Committee (staff-student) – particularly the termly reports on quality of lectures and the practical course
- The External Examiners' Reports and the response of the Department to any issues raised are also considered by the Academic Committee of the Mathematics, Physical and Life Sciences Division and by the University Educational Policy and Standards Committee.

- Student comment on tutorial provision is requested by their colleges and is reviewed by the Senior Tutors of the colleges.
- The Physics Department External Advisory Committee reviews aspects of the undergraduate course from time to time.
- University reviews of the Department by the Division and by the Education Policy and Standards Committee of the University happen every five years (on interleaved 10 yearly cycles).
- Visits by the Institute of Physics Accreditation Panel.
- New academic staff members are offered training in how to teach. Courses are organised by the Oxford Learning Institute, which has been set up within the University to carry out research into the training of university teachers as well as to supplement that research by employing the most effective methods of training.
- Each new member of staff is supported by a departmental teaching adviser, and is assigned an experienced member as an adviser, who is responsible for giving advice and guidance on both teaching and research. Appointments are made for five years in the first instance and a more formal review of the performance of new members of staff is conducted during the fifth year: re-appointment to the retiring age is dependent on both research excellence and demonstration of the ability to maintain a teaching profile of high order, and the review process includes an eye-witness report of one or more lectures or classes.
- First destination statistics: a relatively high proportion of Physics graduates go on to further study, and for those entering employment the quality of the jobs occupied is generally high.

15. Regulation of assessment

Final Examination

The final examinations are conducted by a team of seven internal examiners plus two external examiners. The normal term of duty is three years. Examiners are nominated by a committee of three drawn from recent chairmen of examiners and including the chairman of the Physics Teaching Faculty. They are appointed by the Proctors acting on behalf of the Vice-Chancellor. The external examiners are nominated by the same committee following precepts laid down by the University and Division and informed by the QAA Code of Practice. Although the examiners operate independently they are guided by conventions agreed by the Teaching Faculty, endorsed by the Division and made available to students on line at <http://www.physics.ox.ac.uk/teach/exammatters.htm>. Strict candidate anonymity is observed in all public examinations. Oversight of all public university examinations is carried out by the Junior Proctor and staff. Any complaint or application for mitigation is made through the Proctor.

External Examiners are appointed in order:

- To verify that standards are appropriate to the award, in part by comparison with the standards of comparable institutions, and to ensure that the assessment procedures and the regulations governing them are fair and otherwise appropriate.
- To ensure that the conduct of the examination and the determination of awards has been fairly conducted, and that individual student performance has been judged in accordance with the regulations and conventions of the Examining Board. The external examiners sign the final Class list, along with the internal examiners, as an endorsement that the processes of examination and classification have been fairly conducted.

After the examinations the external examiners submit separate reports (officially addressed to the Vice-Chancellor), which are expected to cover all the following points:

- the standards demonstrated by the students
- the extent to which standards are appropriate to the class of degree awarded
- the design, structure and marking of examination papers
- the suitability of the procedures used in the examination, in this case including not only procedures for the examination papers but also for the oral examination and for the short theses or extended essays, if offered
- whether or not external examiners have had sufficient access to, and the power to call upon, all material necessary to make the required judgements
- students' performance in relation to their peers in comparable courses
- the coherence of the policies and procedures relating to external examiners and their consonance with the explicit role required of them
- the strengths and weaknesses of the students as a cohort
- the quality of teaching and learning which may be indicated by student performance

The external examiners' reports are considered by all the same bodies as consider the reports of internal examiners.

Marking Scale (Finals Papers – maximum 100)		
>70	Class I	The candidate shows excellent problem-solving skills and excellent knowledge of the material and is able to use that knowledge in unfamiliar contexts.
60-70	Class II(i)	The candidate shows good problem-solving skills and good knowledge of the material.
50-59	Class II(ii)	The candidate shows basic problem-solving skills and adequate knowledge of most of the material.
40-49	Class III	The candidate shows some problem-solving skills and adequate knowledge of at least part of the material.
30-39	Pass	The candidate has made a meaningful attempt of at least one question.
<30	Fail	Totally inadequate.

16. Indicators of quality and standards

The following indications have broadly confirmed that the standard of awards is appropriate, and the quality of teaching and research is high.

- External Examiners' Reports
- External Advisory Panel
- Reports of external review bodies (see Sec.14)
- QAA subject review: in the 1999 review, Physics was awarded 23 points out of 24
- Institutional Audit 2004
- Institute of Physics Accreditation Reports

- The Department has achieved a 5* grade in the last two National Research Assessment Exercises
- First destinations of graduates