Photo: Alan Segar

2011 - 2012

Physics

Oxford Physics

Notes for Incoming Freshers

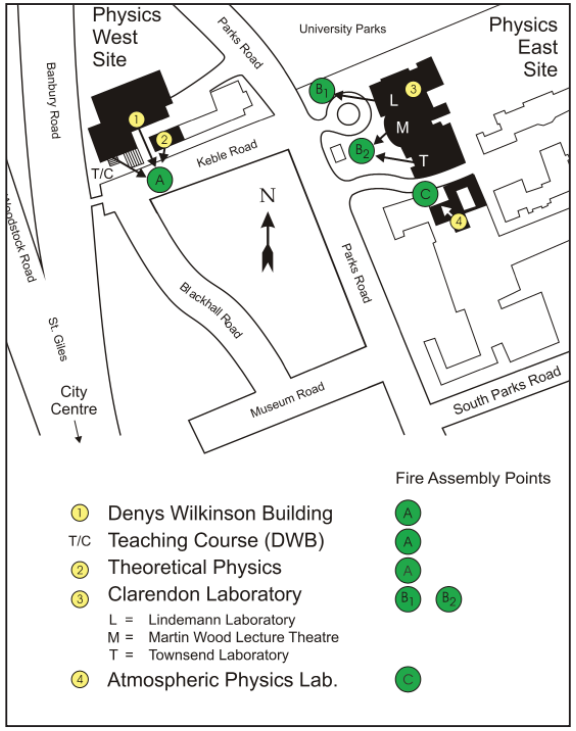
2011-2012

A picturesque view of Oxford

These notes have been produced by the **University of Oxford Department of Physics**. Other documents which may usefully be read alongside this one are :-

1) the leaflet "**Physics at Oxford**", produced by the Physics Department and is available from the Physics Teaching Faculty which is based in the Clarendon Laboratory. The leaflet gives information about all years of the three-year BA and the four-year MPhys courses; Information about the courses is also available on the web at **www.physics.ox.ac.uk**

2) the booklet "**Oxford Physics: The Freshers' Guide 2011- 2012**, produced by undergraduate physics students.



Disabled Students can access the Lindemann and the Dennis Sciama Lecture Theatres by lifts from ground floors. The Denys Wilkinson Building has toilet facilities for disabled students. Provision is made for students requiring a note taker. The Martin Wood Lecture Theatre has access for disabled students, a reserved area within the theatre and toilet facilities. There is an induction loop system for students with hearing difficulties.

The Department is able to make provision for disabled students and those with other special needs. If you think you may need any special requirements, it would be very helpful to us if you could contact the Assistant Head of Teaching (Academic) about these before you arrive.

Teaching and Learning in Physics

Students sometimes have difficulty in adjusting to the less structured pattern of University education, having been accustomed to regular classroom hours and "homework" assignments at school. We think it may be helpful, therefore, to give you some advance idea of the way we operate — especially as the first few days are extremely hectic, as you will discover. The whole of the first term can fly by very quickly indeed!

Lectures

The basic form of instruction is the *Lecture* i.e. one person, using blackboard (whiteboard)/OHP/ slides/PowerPoint presentations/ demonstrations etc., explaining his or her advertised subject to all students in the University wishing to attend (around 180 physicists in any one year). The programme of lectures is worked out so as to cover the syllabus for the relevant papers. The lectures are frequently supported by printed notes, problem sheets, and/or other handouts. We regard attendance as generally *essential*, though it is not in fact compulsory. You will be going to about 4 Maths lectures per week to begin with, and maybe 3 or 4 Physics (or other) lectures. The courses cover a lot of material without repetition. Each lecture builds on the one before and it is important not to miss any if you can help it.

You will need to learn to take good lecture notes, and supplement them with your own private study, using textbooks recommended by lecturers and tutors. Lectures are intended to provide a broad overview of a topic, and cannot possibly cover every detail. It is also useful to approach a difficult question from two or more different points of view.

Tutorials and Classes

Lectures are backed up by *Tutorials* and *Classes*, which are *compulsory*. Whereas lectures are organised by the Physics Department, tutorials and classes (in years 1 to 3) are the responsibility of the Colleges. This doesn't mean that there are two separate groups of staff, one in the Department and the other in the Colleges: all the Physics Department's academic staff are attached to Colleges. At the Department they do research and lecturing, and they also tutor for their Colleges. In tutorials and classes you have direct access to people who are actively involved in research.

A tutorial usually consists of a meeting between two students and one tutor for one hour, but sometimes there can be one, or three students present and the meeting could go on for a bit longer. A class is also a small group, often consisting of just the students in a given year in one college taking the subject, though occasionally classes may be held with another college.

During the first year your time will be divided roughly equally between maths and physics with small group teaching in college, a mix of tutorials and classes - meeting roughly once a week for each subject. For each tutorial or class, work will be assigned in advance often using material prepared by the lecturer with suggested additional reading from your tutor. Much of the work is structured around problem solving but you may be asked to write short essays from time to time. You will usually be expected to hand in the work to the tutor the day before the tutorial or class.

Tutorial and class work will often be organised to be as near as possible in step with the lectures, so as to reinforce them. However, from time to time you'll be asked to work on some topics in tutorials *before* they have been covered in lectures — because, for example, your tutor may think that the development of the subject is better that way. Whatever the reason, the exercise of having to work something out on your own, with the help of books, can be very valuable. Problem sets usually begin with elementary topics which can be answered directly from the lecture notes, but then proceed to more challenging questions. Developing the ability to solve problems independently is just as important as learning facts and standard techniques.

Although you will only have something like two "contact hours" with your College tutors per week, your progress will be followed very closely on a week to week basis. A lot will depend on how *you* use these precious contact hours. You must prepare for them by identifying as precisely as you can the areas which you need help with, either in the lectures or tutorial work. You will soon find that they are an essentially friendly encounter (provided you are working properly!), during which you are encouraged to ask questions and contribute to the discussion.

Practicals

The whole of physics depends on experimental observations, and learning how to make these reliably and quantitatively is an essential part of your education. Practical work is therefore *compulsory*. It is a University requirement that you do the proper amount of practical work, which averages to about one whole day per week for most of the first year. You keep a record of your practical work in 'log-books'; some of your practicals have to be written up in detail and are marked. A termly progress report on your lab work is passed to your College tutors. Practicals are done in pairs and all arrangements will be explained when you arrive here.

Vacations

One very important point to understand is the role of "vacations" in the University year. At Oxford the teaching terms are very short — they add up to only about 25 weeks in one year. Vacations have to include holiday time; and everyone recognises that for many students they also have to include money-earning time.

Nevertheless, it is *absolutely essential* that you set aside significant amounts of time during each vacation for academic work. The course assumes that you will do this. You must go over your lecture notes, revising the material and supplementing it with information gained from tutorials and from your own reading. In addition to consolidating the previous terms work, you should also try to prepare for the next term's courses. Your tutors will often set you *vacation reading* and specific *vacation work*.

Summary

Thus the general pattern of the course is:

- attendance at lectures, including taking good notes
- furthering your understanding of the lectures by self-study of the lecture material, including reading of textbooks dealing with the same topics, as recommended by your tutors
- problem-solving and essay writing for tutorials
- deepening of your understanding in the light of the tutorial work and discussion
- consolidation and preparation during vacations.

The first year course in Physics

This is the 'foundation' year, on which the subsequent years of the BA and MPhys courses both depend. At the end of the year you will sit the Preliminary Examination in Physics ('Prelims'). This is the qualifying exam and must be passed before you can continue your studies at Oxford (a resit is possible in September at the discretion of your college). Prelims consists of three components: (i) four compulsory written papers, (ii) a shorter paper chosen from a range of topics and (iii) evidence of successful completion of practical work during the year.

The four compulsory papers are:
(a) CP1: Physics 1
(b) CP2: Physics 2
(c) CP3: Mathematical Methods 1
(d) CP4: Mathematics Methods 2

The Short Option topics are likely to include:
(a) S01: Functions of a Complex Variable;
(b) S02: Astrophysics: From Planets to the Cosmos;
(c) S03: Quantum Ideas.

Full details are given in the *Physics Undergraduate Course Handbook* (available at the start of each year), but synopses and reading lists for the first terms work will be sent to you by your college.

Almost all students pass Prelims and continue to study physics. It is possible, with the consent of your college tutors, to change to a related subject (for example Earth Sciences or Materials) at this point provided you have passed Prelims.

Learning resources

Books and Libraries

The lecturers for each of the courses issue lists of books they recommend. These will usually specify one core text, or several alternatives, together with some others for further study or reference. Your College tutors will also have suggestions, both in general and also specifically for the subjects in which they are tutoring you. All the recommended books (some in multiple copies) should be in your College library, from which you can borrow them. If your College library doesn't have one of the recommended books, or a book you feel you need, tell your tutor or the College Librarian. Most tutors, however, will expect you to buy a few books yourself: these will typically be ones that you will be using repeatedly for tutorials, perhaps for more than one year (for example "Mathematical Methods for Physics and Engineering" by Riley, Hobson and Bence).

The ultimate collection of books and journals in Oxford is in the University Library, known as the Bodleian Library, which includes a special sub-library for science called the Radcliffe Science Library (RSL). The Radcliffe Science Library is the main science and medicine research library. More details about the Radcliffe Science Library and lending services can be found at http://www.ouls.ox.ac.uk/rsl and http://www.ouls.ox.ac.uk/rsl/services/lending_services. Arrangements for getting access to these libraries (which requires a "University card") will be explained to you by your College.

Computers

All physics students have an account on the Physics practical course computers, which enables them to book practicals, as well as use the computers (we have introductory computer courses for absolute beginners — don't panic!). There is a University-wide network, which enables students to work on their data while back in College. Undergraduates may also have an account on the university computing system. The colleges all have computing facilities for their undergraduates and most college rooms have internet connections for those who bring their own machines.

All new users will be asked to sign an agreement or 'undertaking' to abide by the University Rules on the use of computers.

Monitoring your progress

Basically, there are two ways in which this is done — one by the College, the other by the University. As mentioned above, your College tutors will be monitoring your progress week by week, in tutorials. They will also review the reports on your lab work. At the end of each term, they will make reports on your progress. In addition, they may set you a College (not University) exam called a "Collection" at the start of each term, on the material covered in the previous term, or on the vacation reading, or both. In this way both you and your tutors can see what has been achieved and what needs more work. In some Colleges you can be awarded a "progress prize", and/or a prize for good work in Collections. If progress has not been satisfactory, your tutors will discuss with you what action needs to be taken.

The University assesses your progress via University Examinations. These are the same for everyone, whichever College they belong to (the College Collections vary from College to College). At the end of your first year you take the Prelims exam as explained earlier. This is a pass/fail exam, not divided into First Class, Second Class, etc., although it is possible to get a Distinction. For those who fail one or more papers, there are resits in September. If you fail any resit paper, you generally have to leave (this is a rule common to all University first year courses).

Monitoring our performance

The Physics Department is concerned with ensuring the high quality of all aspects of the physics courses. One of the ways we do this is through the Physics Joint Consultative Committee (PJCC), which consists of elected undergraduate members who meet twice a term to discuss, with academic staff representatives, both academic and administrative matters concerning the physics courses. The Department values the advice it receives from this Committee, the vitality of which is strongly dependent on student enthusiasm and involvement.

Students assess their lectures and practicals each term using on-line lecture and practical feedback forms. This feedback is an important source of information for the Department's own Academic Committee, which organises the lectures and is in charge of the Physics courses. There are also suggestion boxes in all the physics lecture theatres, where students can put comments on lectures, and in the reception area of the practical course for comments on the practical course.

Student support and guidance

Oxford is quite a large University by UK standards, with over 10,000 undergraduates and more than 4,000 postgraduate students. The Physics Department is one of the largest in the country, with about 180 undergraduates entering the Oxford Physics course each year. It could be easy to feel a bit lost among such large numbers of students, but it is here that the strength of the "College system" is most apparent. There are 30 undergraduate Colleges, and you are entering *one* of them. It will be the focus of much of your life at Oxford. All subjects are distributed roughly equally amongst the colleges so that you should soon get to know well the approximately 6 physicists and 100 freshers in your own college.

Most importantly, you will be seeing your College tutors each week for tutorials. Their main responsibility is on the academic side, of course, but they are often the first point of contact if you have a personal problem of any kind. A tutor may be able to offer help and guidance directly, or — most likely — will know whom to advise you to see. Student health and welfare are primarily College responsibilities; tutors, chaplains, and other confidential advisers make up a sympathetic and effective network of support for students. In addition, the University has a Counselling Service available to help students, and the Student Union has officers working actively to promote student health and welfare.

Preparation for your first term

Having emphasised the importance of vacation study, we strongly recommend that you consider doing some preparation for your first term during *this* vacation!

We think there are two areas where some preparatory work is particularly necessary: **Mathematics** and **Mechanics**. As regards the first, you'll find that the physics course here is more mathematically demanding than your A-Level course was. In fact, approximately half the tutorial work in your first year will be devoted to maths. The reason for this is that most of the physics covered in the following years of the course makes essential use of mathematical techniques that go well beyond even Further Maths at A-Levels — and they are introduced in the first year. We design the course so that it can be successfully tackled by students who have not done double maths (Mathematica and Further Mathematics) at A-level (or a comparable course), but single Maths people may find the first year pretty tough. Even if you've done double Maths, you'll begin to meet new material quite soon in the first term, so it's important not to think you know it all: you can soon get left behind. We want your maths to be "up and running" when you get here!

On the physics side, the first subject you'll study is Mechanics. Our students seem to be finding this more difficult than previously. We think that the reason for this may be that the mechanics course quickly begins to make use of a significant amount of maths (e.g. differential equations, and complex numbers). Although students can cope quite well with the maths on its own, what they seem to find hard is *combining* the maths with the physics. This involves, first taking a problem posed in ordinary language and "setting it up" in precise mathematical terms. Then mathematical techniques are used to obtain a solution which has finally to be "translated back" into physical terms. This process may not be very familiar to you from A-Level, but it is going to be very important in your course at Oxford — and it is a skill highly prized by employers! This is why we want to use the mechanics course to introduce students, right at the start, to mathematically-based problem solving, and why we think some preparatory work on solving mechanics problems will be useful for you.

We have collected a set of problems in Mathematics and in Mechanics, which your College Tutor may send you. If you work through these problems, you will be able to identify which topics you are shaky on, or haven't done at all. When you get here in October, your Tutor can discuss the situation with you, and if there are gaps to be plugged, you can be given appropriate material to work on. Your Tutor may have sent you these problems already or may be going to send them — or perhaps an alternative assignment. If in doubt, just write to the Senior Physics Tutor of your College.

Induction

An Induction Session is arranged by the Department of Physics on Friday of week 0. All freshers reading physics and, physics and philosophy are required to attend. The session consists of short presentations introducing the Department and covering important aspects of the course with a tour of the practical laboratories. Students are given their practical course documentation at this session.

Your College will arrange various events during the week before lectures and tutorials start. This week is called "week 0", or "zeroth week". The eight weeks of term proper are "week 1", "week 2", etc. These events in week 0 aim to familiarise you with life at Oxford. There are also some University-based events, notably the "Freshers' Fair" at which you will be invited to join all kinds of clubs and societies.

Issued by the Physics Teaching Faculty, August 2011