Teaching Handbook

for

Cavendish Laboratory Staff

Edition of 30 September 2013

Please send corrections and suggestions for improvement to teaching-office@phy.cam.ac.uk

Contents

1 Introduction

This staff handbook is addressed to both new and experienced members of the departmental teaching staff and to others involved in teaching in the department. If you are new to the Department, welcome! This handbook explains how the teaching of physics is organised in Cambridge, and also gives some guidance in how to prepare your teaching and to develop expertise as a teacher.

2 Equality & Diversity

The University of Cambridge and the Department of Physics are committed in their pursuit of academic excellence to equality of opportunity and to a proactive and inclusive approach to equality, which supports and encourages all under-represented groups, promotes an inclusive culture, and values diversity.

The commitment applies to all protected groups[1] and is underpinned by the University's Equal Opportunities Policy[2] and Combined Equality Scheme[3] (CES).

In recognition of the Department's commitment to progressing equality and diversity, particularly with regard to gender, it currently holds an Athena SWAN Silver award, and the result of our application for Gold should be known in November. Our status as Juno Champion has also recently been renewed.

The Department expects all staff to have a reflective approach, and to adopt inclusive teaching practices. Pointers to some of these, particularly with regard to gender and disability, are provided in appropriate sections of this document.

3 Organisation

3.1 The Teaching Staff and Teaching Duties

The teaching of the laboratory is the formal responsibility of the Head of Department, who delegates much of the work to the *Deputy Head of Department (Education)* and the *Director of Undergraduate Teaching*. These roles are currently filled by Chris Haniff and John Richer respectively. In turn, the Teaching Committee (section 3.8) has a key role in organising and monitoring teaching. You should feel free to contact John and/or Chris to discuss any aspects of our physics teaching, and your role in it.

[1] https://www.admin.cam.ac.uk/offices/hr/equality/characteristics/
[2] https://www.admin.cam.ac.uk/offices/hr/policy/equal.html
[3] https://www.admin.cam.ac.uk/offices/hr/equality/cambridge/scheme/

The teaching staff of the laboratory comprises the University Officers (Lecturers, Senior Lecturers, Readers and Professors) who have a contractual obligation to undertake teaching duties assigned by the Head of Department; this group is sometimes referred to as the "established" staff in University jargon, and is defined in "Statute D" of the University's Statutes and Ordinances (http://www.admin.cam.ac.uk/univ/so/2012/statute_d-front.html). In addition, we are fortunate to benefit from significant contributions from our postgraduate and graduate community. Although in general senior postdoctoral staff (such as Royal Society URFs and the like) have no obligation to teach, they are encouraged to contribute to the laboratory's teaching where possible, in the expectation that this could be of value to their career development. These contributions are highly valued by the Department, and all postdoctoral staff are encouraged to discuss their possible contributions with the Director of Undergraduate Teaching.

Generally we expect all established staff, from recently appointed lecturers to the most senior professors, to do a fair share of departmental teaching and examining. The number of available established teaching staff at the Cavendish is currently about 50 once sabbatical leave is taken into account. With current student numbers, an *equal* division of the total *departmental* teaching duties among these 50 people suggest established staff might *typically* be required each year to carry out duties equivalent to those on this list:

1. lecture one undergraduate/MASt course (12-24 lectures);
2. act as a day head of one practical or examples class;
3. offer to supervise at least two Part III projects;
4. offer to supervise one or two Part II Research Reviews;
5. offer about 20 hours of Part II supervisions;
6. assess several units of Part II further work (research reviews, computational projects etc) and Part III Projects;
7. examine in (on average) three years out of four;
8. assist from time to time with administrative duties required to keep the teaching programme running, for example sitting on the Cavendish Teaching Committee and helping with reviews and monitoring of our courses.

Of course this is not how teaching duties are actually allocated, but it is perhaps a useful reference point, illustrating what a fair teaching load might look like in practice. (In reality, the supervision load in Part II is lower due to contributions from doctoral and postdoctoral staff, and some lectures and projects are offered by colleagues from other departments.)

It's also worth noting here that student admissions, and supervision in Part IA and Part IB, are the responsibility of the *colleges* (section 3.4) and remunerated separately, although of course much of this work is done by Cavendish staff.

You will receive each year a formal letter allocating your teaching duties for the coming year**. It is vital that you respond immediately to the Teaching Office to accept these duties,** or else contact the Director of Undergraduate Education if further discussion is needed.

Teaching work loads are carefully monitored by the Teaching Committee via the Personnel Committee's annual Work Load Survey and will vary with circumstances; preparation time for new courses, committee work and other factors are taken into account as far as is possible. **Staff are kindly re-**

quested to complete the Work Load Survey promptly when asked. The Teaching Committee tries where it can to match people's teaching preferences and skills to courses, with the goal of maximising the quality of our degree course. The Director of Undergraduate Teaching is always happy to discuss teaching duty allocation with staff.

3.2 Sabbatical Leave

Teaching staff entitled to sabbatical leave must follow the usual University rules, and guidance can be obtained from the Head of Department's office including the minimum advance notice required. It is critically important that you give as much advance notice as possible to the Teaching Committee, preferably more than the statutory minimum, so that the plans can be made for teaching duty allocation. Even if your plans are tentative, the Teaching Committee welcomes advance warning of possible absences.

3.3 Absence During Term Time

The expectation is that teaching staff will be available for teaching duties during Full Term. Requests for Short Leave for periods of between two and fourteen nights during Full Term need to be authorised by the Head of Department, who will consult the Director of Undergraduate Teaching, and the Deputy Head of Department (Education) to assess any impact on teaching. Full details of the Department's Policy can be found at http://www.phy.cam.ac.uk/resources/hod.php .

3.4 The Department and the Colleges

Students are admitted to Cambridge by the individual colleges. In college, each student usually has a *Tutor*, who is responsible for general wellbeing, and a *Director of Studies*, who is responsible for academic progress. Although some colleges do things slightly differently, it is always possible to find someone answering to these descriptions. The University provides, through the Department of Physics, lectures, practical classes, examples classes, a Departmental library (the Rayleigh Library) and examinations in physics. The colleges are responsible for providing small group teaching known as *supervisions* for which students present written work. However, in the third and fourth years of the physics course the Colleges delegate the organisation of supervisions to the Department.

3.5 The Natural Sciences Tripos and the MASt

In Cambridge the physics courses form part of the *Natural Sciences Tripos* (http://www.cam.ac.uk/cambuniv/natscitripos/). Our first year courses are also available to students in the Mathematics and Computer Science Triposes. There is considerable flexibility, with switches possible between Triposes; details are given in the Physics Course Handbook. The standard Natural Sciences route to graduation in physics is as follows. The first year (Part IA) is a general science course in which physics is combined with two other experimental sciences and mathematics. Some 400-450 students attend our first year lectures and practicals. Of these, about 180 move on to two

second year (Part IB) physics courses, Physics A and Physics B. This is combined with one other subject, most commonly Mathematics. Of these students, about 150 go on to specialise in Physics in the third year (Part II). Students may graduate with a B.A. honours degree at the end of this third year. Those who wish to pursue physics at the Masters level, and who meet the qualifying requirements, do not graduate at the end of this third year; instead they continue with Physics in the fourth year (Part III) and graduate with two honours degrees, a B.A. and an M.Sci., at the end of that year. A majority of our Part II class typically choose to continue to Part III.

Students, usually from other universities and who already have undergraduate degrees in Physics, may take just the final year (Part III) of the undergraduate course. They take the same exams as the continuing students; successful candidates are awarded the Master of Advanced Studies (MASt).

3.6 Examinations

Examinations in physics form part of the Natural Sciences Tripos. Examiners, and Senior Examiners for each body of examiners, are nominated by the Head of Department and appointed by the Education Section of the General Board by the start of the academic year. External Examiners are also appointed for Part II and Part III.

The examinations are set according to rules laid down in the University Statutes and Ordinances, and formal guidelines from the Department.

For Part I and Part II the questions are proposed by the Examiners themselves, but are also sent to the lecturers concerned, who check them for accuracy and appropriateness; however the final responsibility for the questions lies with the Examiners. Typeset model answers must be prepared by the Examiners.

For Part III the various topic lecturers are appointed as *Assessors*. They set and mark questions for their own courses. Model answers are again required, and the questions are checked by the Examiners.

In all years, the Head of Department, through the staff, is responsible for supplying the Examiners with assessments of coursework performed during the year.

If you are appointed as an examiner, please read §10 (Examining), and consult the Director of Undergraduate Teaching if you need further advice.

3.7 The Lecture List and Course Handbook

The University Lecture List can be found on the web[4].

Details of the courses appear in the Physics Course Handbook, also known as “The Blue Book”; see §4 (Course structure and the Physics Course Handbook).

3.8 The Teaching Committee

The Teaching Committee organises and monitors all undergraduate teaching, including examinations and general syllabus development. It is chaired by the Director of Undergraduate Teaching

[4] timetables.caret.cam.ac.uk

(director-teaching@phy.cam.ac.uk); from October 2013 this will be John Richer (jsr10@cam.ac.uk 37246). It has about ten to twelve members, who normally serve for about four years. General policy issues should be taken up with the Chairman, administrative matters should be taken up with the Secretary, currently Dave Green (dag9@cam.ac.uk). The Deputy Head of Department (Education), Chris Haniff, also attends.

The teaching web pages at http://www.phy.cam.ac.uk/teaching/contacts.php contain links to the committee membership and terms of reference.

3.9 The Teaching Office

The Teaching Office (room 212B) lies in the main administration area on the first floor of the Bragg Building, and the Teaching Office Administrator (Helen Marshall; teaching-office@phy.cam.ac.uk; 65798) will be found there. The Office, together with the Senior Teaching Assistant (Harry Druiff; hwd20@phy.cam.ac.uk; 37432), is responsible for organising lecture theatres, practical classes and examinations, maintaining student records, and producing Departmental teaching documents (but not course handouts). The Office carries a heavy workload. Teaching Staff should please **not** give work to the Office directly, but negotiate first with the Director of Undergraduate Teaching.

3.10 The Undergraduate Consultative Committee

Elected student representatives meet staff members at the Undergraduate Consultative Committee, which meets once a term. This committee issues and considers questionnaires on all courses, and is the most important source of feedback for the Teaching Committee. From 2013-14 its Chairman will be Julia Riley (jmr2@cam.ac.uk); the other staff members are the Director of Undergraduate Teaching, the Secretary of the Teaching Committee, and the Head of Department or their delegated representative.

3.11 Staff Meetings

Staff Meetings are usually held on the first Wednesday of each term. In addition, we have two special meetings each year, one at which supervisors and college directors of studies are invited to discuss issues with lecturers, and one at which all teaching staff are invited to discuss matters of interest, including planned changes to the course.

3.12 University Bodies

This list is not exhaustive.

Faculty Board of Physics and Chemistry. This, with the corresponding Degree Committee, which has much the same membership, covers the Departments of Physics, Chemistry, Materials Science & Metallurgy and the Institute of Astronomy. It has student members, meets regularly, and provides an important conduit on educational and other matters between the physical science departments and major bodies such as the General Board.

Natural Sciences Tripos Management Committee. Meets regularly to discuss administration and detailed changes to the Tripos.

Mathematics Liaison Committee. Meets when required to discuss mathematics within the NST.

School of the Physical Sciences. Concerned with major resource issues such as buildings and staffing levels. The School is governed by the **Council** (CSPS), with the **Needs Committee** (Heads of Department) being responsible for the School finances.

(School) Undergraduate Education Committee (UEC). Meets termly to discuss cross-School educational issues, to inform the School's input to the NST Management Committee.

General Board. The final arbiter on resource allocation (through the Councils of the Schools) and educational matters.

General Board Education Committee. Responsible to the General Board; advises GB on all education-related matters.

Deputy Academic Secretary. The source of all wisdom on formal Statutes, Ordinances and Regulations and deals with student records and formal examination arrangements.

Education and Student Policy (ESP). Deals with many educational issues, such as course proposals, examination requirements, assessment methods and quality assurance. Mrs Elaine Oliver (64853, elaine.oliver@admin.cam.ac.uk) acts as Secretary to the NST Management Committee.

Board of Graduate Studies. Deals with all graduate education including M.Phil. courses.

Colleges' Committee. For discussion between colleges. Considers relations between Colleges and University, including supervisions.

Senior Tutors Standing Committee on Education. Raises general issues of concern to the colleges; responds on behalf of the colleges to proposals for changes to courses.

Admissions Office. Students in Cambridge are formally admitted by the Colleges. The University Admissions Office[5] acts as a central enquiry point for prospective students and coordinates many activities related to admissions.

3.13 National bodies

Higher Education Funding Council for England (HEFCE). Provides funding to English Universities, both directly as a block grant for teaching ('T' funding) and also as a block grant for research ('QR'), with the amount depending on the results of the previous Research Assessment Exercise (RAE – to be renamed Research Excellence Framework, or REF, from 2013).

Quality Assurance Agency (QAA). Originally established to conduct reviews of university departments about once in five years. Cambridge scored 23/24 in the review of physics and astronomy in November 1998. More recent reviews have been institutional and thematic.

Office of Fair Access (OFFA). Responsible for ensuring that Higher Education Institutions achieve "fair" representation of students from social and ethnic minorities, or those without a history of university attendance. It is a condition of being allowed to charge the higher fee rate that universities meet the conditions of their individual "Access Agreements".

[5] http://www.admin.cam.ac.uk/offices/admissions/

Office of the Independent Adjudicator (OIA). Essentially an ombudsman which hears appeals from students concerning academic process.

Institute of Physics. Takes an active interest in the development of school and university physics courses; see their website (http://www.iop.org/). Our physics courses have been accredited by the IoP, most recently in 2012. The Departmental representative of the IoP is Mike Payne. The Department arranges free membership for all students.

3.14 Teaching facilities

3.14.1 Lecture theatres

Part I lectures are given at various locations in the centre of Cambridge, Part IA in the Bristol Myers Squibb lecture theatre in the Chemistry department on Lensfield Road, and Part IB (mostly) in the Cockcroft lecture theatre on the New Museums Site; Harry Druiff (37432; hwd20@cam.ac.uk) assists with lectures in the Cockcroft and John Flynn (37407; jjf35@cam.ac.uk) is responsible for support for the Bristol Myers Squibb lectures. Part II and Part III lectures take place in the Department, with most Part II lectures in the Pippard lecture theatre, and Part III lectures distributed between the Pippard and Small lecture theatres, and the Mott and Ryle seminar rooms. Harry Druiff (37432; hwd20@cam.ac.uk) is in overall charge of the lecture theatres and co-ordinates assistant support of lectures. Notices showing theatre allocations are placed on the notice boards outside the Pippard Lecture Theatre. Some Part II lectures may also take place in the Sackler lecture theatre at the Institute of Astronomy, across Madingley Road.

3.14.2 Practical laboratories

The Part IA and IB Teaching Laboratories are in the Bragg Building. The assistant in charge of the labs is Richard King (37405, rjk45@cam.ac.uk). Most Part II experiments take place in the Bragg Building teaching labs, while the others take place in research groups. Most experimental Part III projects are carried out in the research groups.

3.14.3 Print room

The print room is behind the reception desk in the Bragg Building (tel 37398). A4 master copies of material required for lectures and practicals should be left there at least **two weeks** in advance. The print room knows how many copies are required for students, supervisors etc: you need only specify any extra copies you want for yourself. The printed output is usually sent directly to the lecture or class assistant concerned.

Note that all handouts are now uploaded to the Teaching Information System (TiS), and anyone who needs one can request a printed copy from the Teaching Office. In order to reduce waste, you are encouraged to have printed only the bare minimum number of copies in the first instance. Before the introduction of the TIS we were printing some 3 million pages a year, of which 600,000 (1200 reams; 240 boxes of paper) were surplus to requirements, and had to be recycled.

3.14.4 Libraries

In Part I, most students use their college libraries, and the Department issues a list of recommended purchases to colleges.

The Rayleigh Library has a special section, with overnight borrowing, for Part II and Part III students, who are also free to use the main section. Books recommended in lecture synopses are normally

purchased automatically by the librarian, Ms Nevenka Huntic (nh240@cam.ac.uk), but it helps if she is given early notice. The student section also contains files of course materials of various sorts.

After they have been distributed to students, spare copies of Course Handouts and Lecturers' Examples are placed in filing cabinets outside the Pippard Lecture Theatre, and staff who need copies for supervising etc. collect them from these cabinets. All handouts are available in electronic form from the web via http://www.phy.cam.ac.uk/teaching/webpages.php.

3.14.5 Managed Cluster Service (MCS)

The Cavendish has a MCS near the Part IA practical class, which is used by students for various sorts of work, notably the computing coursework in Parts IB and II and computing projects in Parts II and III. Richard King (37405, rjk45@cam.ac.uk) will help with advice and practical arrangements for using the MCS.

3.14.6 Supervision rooms

Supervision is normally done in staff offices, but there is also a small number of rooms available on the bridge between the Bragg and Rutherford Buildings, which can be booked through your group administrator or the Teaching Office (teaching-office@phy.cam.ac.uk; 65798).

3.14.7 Formula Handbook

Students can obtain from the stores copies of the Mathematical Formula Handbook issued by the Department, which is used in physics examinations (but not in mathematics examinations). This handbook is updated by Dave Green (dag9@cam.ac.uk). It is also available on the web[6].

3.14.8 Departmental website

Our website (http://www.phy.cam.ac.uk/teaching/) is the principal resource for information about the teaching programme. Webpages are maintained by Helen Marshall in the Teaching Office – please contact her if you notice any errors or omissions. Dynamic content relating to individual courses is managed through the Teaching information System (see below).

3.14.9 Teaching information System (TiS)

The TiS is a Virtual Learning Environment (VLE) tailored particularly to the needs of the Department. All staff members, students, supervisors and Directors of Study are given an account on the system. Among the principal functions of the TiS are:

- Managing offers of, requests for, and allocations of, those Part II and III supervisions for which the Department is responsible.
- Recording of Part IA and IB practical marks, and of marks for Part II Further Work.
- Managing offers of, and allocation of, Part II Research Reviews and Part III projects.
- Provision of full sets of course handouts, for the current and previous years.
- Provision of past Tripos papers
- A database of vacation work opportunities, with simple Wiki to allow students to share their experiences.
- On-line access to minutes, agenda and other meeting papers for teaching-related committees.

[6] http://www.phy.cam.ac.uk/teaching/FormulaBook/formulae.pdf

3.14.10 MatLab

The University currently has an (annual) site licence for the use of MatLab software. This allows the software to be installed on all machines owned by the University (taken to include the colleges), as well as those owned by members of staff. From 2010-11, the Part IA computing course has used MatLab as a general tool. The course runs in Michaelmas term, so that from Lent Term on, it can be assumed that all physics students will know how to use the software, at least at an elementary level.

The Teaching Committee encourages all lecturers and heads-of-class to make use of MatLab software in their teaching, both for examples during lectures, and also as a tool in solving problems on the weekly problem sheets. While students tend to assume that the only point of the problem sets is to provide instruction in and practice for Tripos, the judicious use of computers for problem solving is a key transferable skill, and one we would like to embed.

The University also has an annual student licence, which allows students to install the software on their own machines.

3.14.11 Notice boards

Official notices for students are placed on the Class Notice Boards for Parts IA and IB, and on the Notice Boards outside the Pippard Lecture Theatre for Parts II and III.

3.15 Finance

Minor items needed for lectures or classes can be obtained from stores and signed for under 'teaching/classes', or ordered through Richard King (rjk45@cam.ac.uk). The budget is held by the Deputy Head (Teaching) and substantial expenditure (>£500) **must** be negotiated via the Teaching Office.

4 Course structure and the Physics Course Handbook

The aims and structure of the courses are set out in the Physics Course Handbook, or 'Blue Book', which is issued to staff and students each year in October, by the Teaching Committee, and is available on the Departmental web-site[7]. It also describes the detailed arrangements for all teaching, and contains the course synopses. Staff should note in particular

- The general description of the courses, with flow-chart of options (only those connected by bold lines form part of the IoP accredited pathway).
- The description of our Aims & Objectives[8].
- The more detailed descriptions of each year, especially the detailed arrangements for all the options in Part II and Part III.
- The exchange arrangements under which a few selected students attend courses at MIT instead of taking Part II in Cambridge, and MIT students (and other exchange students) attend our courses. (Note that the physics exchange with MIT has been suspended from 2011 and until further notice: consult Rachael Padman, rp11@cam.ac.uk for more details.)
- The Guide for Students.

[7] http://www.phy.cam.ac.uk/teaching/
[8] http://www.phy.cam.ac.uk/teaching/external.php

The Handbook is edited by Helen Marshall in the Teaching Office (teaching-office@phy.cam.ac.uk), to whom any errors should be reported.

5 Developing teaching expertise

For new staff members, the Deputy Head (Education), Chris Haniff (cah1008@cam.ac.uk), is responsible for induction. New staff will be encouraged to study:

- a free copy of Brown & Atkins, *Effective Teaching in Higher Education*, Routledge (1988);
- the current edition of the Physics Course Handbook, which sets out the aims and structure of our courses;
- the general advice on teaching given in later sections of this handbook.

In addition, the University Centre for Personal and Professional Development (PPD) organises a wide range of courses for new staff: the current list may be found on the web[9]. If you have no experience of a particular aspect of teaching, you will be strongly encouraged to attend the relevant course. Details of these courses, and how to book a place on them, can be found on the University web-site[10].

Arrangements will be made for an experienced teacher to act as a 'mentor' to new staff members by sampling their teaching and providing feedback. A video camera is available for recording lectures, and the Deputy Head (Education) and the Chairman of the Teaching Committee will always be pleased to discuss teaching methods or to offer advice.

More experienced staff will be guided in developing their teaching skills particularly by feedback from student questionnaires, the Undergraduate Consultative Committee and the Teaching Committee. In addition, experienced staff will wish to maintain their expertise by

- getting and reading a free copy of Brown & Atkins;
- reviewing their aims and methods regularly;
- attending University courses from time to time;
- organising informal mentoring of their teaching from time to time; and
- keeping up-to-date on changing methods in, for instance, use of lecture equipment, styles of overhead and handout, best practice in examples sheets and use of the web.

Members of the Teaching Committee will be pleased to help and advise.

[9] http://www.training.cam.ac.uk/cppd/
[10] http://www.admin.cam.ac.uk/offices/hr/cppd/

6 Lecturing

6.1 The point of lectures

It is sometimes asserted that lectures are unnecessary. There is, however, a strong tradition in the Cambridge science departments that lectures matter, and they are generally well attended. There are several reasons for this.

- The lectures set the pace, and force the student to move forward through the course. In a subject like physics where one topic depends on another this *structuring* is absolutely vital.
- The lectures should generate enthusiasm and inspiration; in a good lecture the student feels in contact with a real expert who loves the subject and is anxious to pass on its beauties and subtleties.
- With a large audience in particular, there is a strong sense of occasion. It is in the lectures that the students identify themselves with the traditions of the subject.
- Demonstrating, in real time, how to approach and tackle a problem, or to carry out an experiment, cannot be done in a book.
- Physics is largely about clear thinking and styles of thinking, and such things are far more memorable when associated with a real person. We have to *persuade* students that they can think in new ways, so that they sigh to themselves 'Ah, yes, *now* I understand!'.

It is clear that good lecturing involves elements of showmanship, inspiration and style as well as clear exposition, precision and economy.

6.2 Lecture technique

We can all remember disastrous lecturers, but it takes practice not to fall into the same traps.

Timekeeping: The usual rule is to lecture for 50 minutes, starting five minutes after the hour and finishing five minutes before. If you know that none of the students is coming from another lecture, you can legitimately start on the hour, but *always* leave time for private questions at the end. Explain your policy to them.

Audibility: Consciously address those in the back row, not the front. There is no need to shout, but use a slightly high-pitched, carrying voice; head well up; don't drop your voice at the ends of sentences. If the lecture theatre has a public address system, you *must* use it, even if you think your voice is loud. Our main lecture theatres are equipped with a loop system for students using hearing aids, but it doesn't help unless you use the microphone and make sure that the system is switched on.

Legibility: Almost everyone uses data projectors or overhead projectors, and nowadays both are available in all the main lecture rooms. But you still have to make sure that the writing or printing is large enough for those at the back and sides. It's essential to try it for yourself in the lecture theatre you will use. Remember that some students will have poor eyesight or be red—green colour blind,

and that some colours which look good on your desk may not be readable when projected. Advice on the effective use of colours is available on the web[11].

Lighting: If you use an OHP, data projector or slides, make sure the room lighting is dim enough to see the projected image clearly, but still bright enough to allow note-taking. If you use a blackboard, it *must* be properly cleaned and brightly lit. Practise controlling the room lights before your first lecture. Turn the lights up whenever possible, to discourage drowsiness in your audience!

Two projectors: Many theatres have two overhead projectors. If so, be careful to use them in a systematic way. One method is to have the new transparency always on the students' left and the old one on the right. Or you may prefer to keep one for the main notes and the other for illustrative figures and graphs. But if you're not systematic, the students will get confused.

Pointing: You must find some method of pointing to items on the screen (i) without obscuring the screen from any seat, and (ii) without making yourself inaudible (this is another good reason to use a microphone). If you use a laser pointer, make sure it is really visible; old fashioned technology (a long stick) may be better.

Structuring the lecture: Students complain surprisingly often that they can't follow the *structure* of lectures. Make sure that they know when you are starting a new section or topic. Tell them what's coming, then do it, then tell them you've done it. Make sure that numbering systems on overheads and handouts are logical and consistent. Consider whether to give summaries at the beginning and end of major topics, or of the lecture, and/or a preview of the next lecture.

Pace: The proper speed of a lecture depends on how you use handouts. At one extreme, a full handout which duplicates the lecture overheads means that many students will abandon note-taking altogether. You can then go faster, but this may not be a good idea, because it may be too fast for proper digestion, and the audience may go to sleep (or fail to appear). At the opposite extreme, if you use a minimal handout, or one very different from your overheads, the students will have to take full notes; you must then go very, very slowly.

(There is more on handout style in §6.4 (Lecture handouts) below.) Lecturing too fast is the commonest error of novice lecturers, who forget how long it takes students to write effective notes, or how quickly students can absorb the new ideas you are teaching them. Two factors tend to worsen this error: the use of prepared overheads rather than writing during the lecture, and recent experience in giving highly condensed conference presentations. Two techniques help. Always watch carefully to see when the class has stopped writing — and be prepared to wait in silence. And if what you're covering is already in your handout, remember to tell them where, so that they can follow without writing.

Variation within the lecture: Educationists agree that the natural attention span is much less than 50 minutes. This means that you should try to vary and break up the lecture in some way, for instance, with a demonstration, with rhetorical questions or challenges, an anecdote or (in small classes) with question and answer.

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[11] See http://jfly.iam.u-tokyo.ac.jp/color/

Personal factors: Nothing brings a lecture to life like showing how you yourself make use of its subject matter in your own research. Be friendly, and don't be afraid to show that you find things intriguing or exciting; at age eighteen what did *you* want from your lecturers? Let the students see that the understanding of physics is a personal thing; there is no `best' way – they have to find for themselves the mode of understanding which satisfies them best.

Maths vs. physics: It pays to distinguish carefully between explaining the physical arguments and `turning the mathematical handle'. Both need proper exposition. Some lecturers never really explain the physics but set out the mathematical analysis very clearly, while others concentrate on the ideas and wave their hands vaguely over the analysis. Students generally dislike both extremes. If you choose to omit mathematical details it's best to do it wholesale and to make absolutely clear what you've done.

Examining: Other than in Part III, Lecturers are not expected to examine the courses they teach. Examiners will however ask for feedback on possible questions, to check that the topic(s) have indeed been covered in lectures, at the expected level. Lectures should also check the model answers to ensure that they are consistent in style with the lectured material – for example, it would be unfair to expect lots of analysis in an examination question when the lectures had been largely qualitative.

Gender bias: The Department is committed to equal opportunities in all aspects of our activities, and gender bias is one of the most sensitive issues involved. We know that some women students find certain aspects of the course intimidating. Please encourage the women students when you see the opportunity, and ensure that there is nothing in your lectures which might seem hostile to them – or to any other group of students, such as ethnic minorities or handicapped students.

Effects of this sort may not be obvious at first sight. Although the world is changing rapidly, you would probably be wise not to assume that all students know what a pile-driver is, or find the physics of weapons attractive, or relish folk tales of physics as competition rather than cooperation.

All members of staff are expected to undertake the University's on-line Equality & Diversity training module. Following feedback from staff, a new version of the training will be available from Autumn 2013, but even the current version is very useful, and some aspects of the module may surprise even the most aware staff. The module takes around on hour to complete.

Mistakes: Try hard to eliminate trivial mistakes such as sign errors: students find them very irritating. If they hiss and you can't see your error at once, ask them politely where the error is. If you make a more substantial mistake, it is good policy to admit it without embarrassment, and, of course, to correct it. We all make mistakes, and it shows that physics lecturers are human, after all. If you are challenged but unsure, it may be best to defer the issue to the next lecture, to be quite certain that you don't make confusion worse confounded. But make sure you do sort it out.

Safety: Find out from the assistant what safety rules apply in the lecture theatre. You must know what to do if there is a fire alarm, what alternative escape routes exist, and where the assembly point for the students is.

You must also of course carefully consider the safety aspects of any demonstrations that you might wish to use in lectures. A risk assessment must be carried out for every demonstration – refer to the Health & Safety pages[12] for details.

6.3 Planning the course

Allow plenty of time. Given that you have other responsibilities, six months could be all too little in which to prepare a course. It will certainly take at least a day to prepare each lecture; possibly more.

Apart from Part III Minor Topics, you are unlikely to be asked to design a course from scratch. There will almost certainly be a synopsis which has been settled after extensive discussion with and by the Teaching Committee, which experience has shown can be taught successfully in the time available. Start by asking your predecessor as lecturer for sight of his or her lecture notes or overheads (or view them on the TiS). Go right through them, and then discuss at some length why the course was constructed as it was. You will usually discover that there are important links with both earlier and later courses or with practical or examples classes; if so, make yourself familiar with those courses too, and talk to the staff concerned. Explore at this stage the standard textbooks.

The next stage is to consider changes in the synopsis; you may have ideas of your own, or the Teaching Committee may have already requested changes. Any revision of the synopsis *must* be discussed with other affected lecturers and must be approved by the Teaching Committee; even changes in sequence within your course may affect other concurrent courses. It must also be complete in time to be included in the Physics Course Handbook (you will be asked for it around June).

Before getting down to detail, prepare for yourself two reminders: a brief list of your main *objectives* — what is it that I really want the students to be able to *do* at the end? — and a list of the constraints imposed by *coordination* — what links must I establish with other courses (including maths courses and practical and examples classes) before, after and concurrently? As well as content, revision and level of sophistication, the coordination will involve such things as common notation and vocabulary. The Department has a policy of adhering to the Royal Society conventions for standard symbols, units, and the labelling of axes and tables; there is a booklet setting them out in the Rayleigh Library (classmark 11 R 2), which can also be purchased from the stores. It saves much trouble later if you get all your notation straight at this stage.

You will then be free to get down to detailed planning. Now is the time to make quite sure that you understand all of the physics yourself. Settle in your mind the logical sequence of everything in the course, and how you intend to present every argument. (A danger here is the temptation to think that sophisticated compactions make the subject easier for students. We have all, in our time, wondered whether one could not teach special relativity using 4-vectors from the outset. But the fact is that many such 'simplifications' only really seem simpler to those who have already mastered the basics. For most students it is best that the first introduction to a new idea should be in very simple and concrete terms.) You can now prepare an outline plan for each lecture.

Once the logical structure is clear you can prepare your actual lecture notes and/or overheads for perhaps the first third of the course. Unless you are very experienced, there is no point in going fur-

[12] http://www.phy.cam.ac.uk/hands/information/riskasst.php

ther until you have discovered whether the first few lectures are going too fast or too slowly. In most lecture theatres, you will need to use a font size of at least 18 pt on your overheads. Lecturers vary considerably, but with some figures and diagrams, and assuming that the students need time to translate them into effective notes, you will probably find it difficult to cover clearly more than about 10-15 overheads per lecture; some lecturers use fewer.

Note that in certain areas the Department adheres to particular conventions – for example, in relativity, that the mass is invariant, and that therefore □ = □□□ etc. Again, it is worth checking carefully what your predecessor has done, and asking for clarification if the approach seems unusual.

Finally, prepare appropriate handouts, lecturer's examples and demonstrations (see below).

6.4 Lecture handouts and textbooks

Opinions amongst lecturers differ on whether and how best to use handouts, and our policy is not to be prescriptive. However, students always ask for handouts to be better and more comprehensive, and over time handouts have altered in the direction demanded; improvements in technology have enabled them to become ever closer to textbooks in terms of length, completeness, and quality of presentation. At the same time, the use of standard texts has declined, to the point where students often feel cheated if asked to work from a textbook (and especially, and perversely, if it is one written by the lecturer and/or his colleagues). A too-complete handout also encourages students' belief that this is *all* that one needs to know about any particular subject. We think this is a shame, and would like to reverse this trend.

While we understand that for many lecturers, the production of a textbook-quality handout is of itself satisfying, as well being an excellent way to structure one's thought and the ensuing course, we question whether this is always the best use of a lecturer's time. There are many excellent textbooks already out there; college libraries often hold multiple copies; and they generally have the advantage of having been carefully proof-read and revised. Many, especially at Part I and II level, also come with full sets of examples. Unless you intend to publish your handout as a textbook, it may be more cost-effective to use an existing one.

Even if the material you wish to cover is not covered completely in any one textbook, it may be that a book can still be used as the basis of the course, with handouts being used just for additional material.

However you decide to use handouts, the following points seem fairly uncontroversial.

- The structure of the course must be clear from the handout — students do sometimes miss lectures!
- It is usual practice to reproduce in the handout the course synopsis and advice on textbooks given in the Physics Course Handbook.
- Most algebraic developments should be in the handout because the process of getting them down correctly as handwritten notes is both distracting, time consuming and prone to error.
- All but the simplest graphs and data tables which need to be retained must be reproduced in the handout — it is too difficult to copy them by hand.
- It helps the students if the handouts correspond closely with your lecture overheads in numbering and layout, so that they can see at once when they don't need to write notes.

- There must be a set of lecturer's examples with answers (see below).
- If your handout is long, an index and clear sectioning is very helpful.

How full one makes the handout is a matter of taste. Perhaps the most useful comment is to remark that a *moderate* load of note taking can be an important part of the mental digestion process, especially for the best students, but a situation where the weaker students are so frantic to get everything down that they can't think about what you're telling them is a disaster. For this reason an over-thin handout is a worse error than an over-fat one — unless you are prepared to lecture very, very slowly. A full handout is particularly important in the first year (when students are unused to note-taking), in cases where the textbooks are inadequate, or when you are adopting an unusual approach. It is worth remembering that the handout informs supervisors and examiners as well as students about your approach.

The handout should be presented to the print room in A4 *facsimile*. Items do not all have to be given out at once, but if you have the energy to get it all done before term starts, then everything can be bound into a single volume by the print room, which the students are less likely to lose. Allow the print room at least a fortnight to print it. You are encouraged to upload all handouts (and related material) to the TiS yourself, but alternatively you can email them to the Teaching Office, who will do it for you. In extremis they will upload a scanned version, but this is likely to be of inferior quality.

Copyright law in the UK is very strict. *All* copying is subject to "fair use" restrictions, which generally limit the amount of material you can copy to one chapter of a book or one paper from a journal. Restrictions on material posted on the web are even tougher, and it is only legal to distribute copyright material on the web if access is restricted to those taking *that* particular course, in *that* particular year[13]. We therefore ask you not to include copyright material directly in handouts, but to print and distribute it separately, as hardcopy-only. It is hoped that the TiS can be modified in future to meet the legal requirements.

No matter how complete the handout, you are still expected to provide a list of suitable text books. Students in Cambridge are generally not expected to buy large numbers of texts, although they will happily purchase those that seem to be of value, often second-hand from students in the previous year group, and most colleges make available small book grants for this purpose. However, college libraries are also happy to stock multiple copies of the most useful texts, and will take their cue from your booklists, which are aggregated and distributed to all colleges early each summer. So please ensure that the recommended texts are actually useful (and in print), and be sure to indicate those which are of peripheral interest, or which may be so expensive that college libraries would not be expected to purchase additional copies.

6.5 Demonstrations

Demonstrations, films and computer simulations can be time-consuming in lectures, and their appropriateness will vary from course to course. They provide, however, an excellent way of varying the pace of a lecture, and reminding ourselves that the subject is about real and sometimes messy phenomena. Students like them. Every course should include interesting and illuminating demonstration material.

[13] See http://www.caret.cam.ac.uk/copyright/ for an introduction to a complex topic.

Preparing them is hard work. The lecture assistants (see §8.7 Class assistants) will help you find advice and assistance. There is a store of old demonstrations (near the Part IA Class), and useful films and computer programs are available commercially. Funds are available for the purchase of equipment for demonstrations – if we don't already have the experiment you want, then please discuss the matter with the Deputy Head (Education).

For the large audiences in Part I thought must be given to making the demonstrations visible to all of the audience. The lecture theatre assistants (see § 8.7 Class assistants) will help with setting them up and the use of CCTV.

You are reminded again that you *must* consider safety aspects of any demonstration. Conduct a risk assessment and discuss it, as appropriate, with the Laboratory Safety Officer.

6.6 Lecturers' examples

Lecture courses should be accompanied by an examples sheet, for use in supervisions. This is a crucial element of the teaching, which complements the lectures. To maintain proper balance between courses, you should not normally set more than two examples per lecture, unless they are really very short. In preparing a new lecture course, it is a common mistake to devote insufficient time to preparing an educationally useful set of examples. In setting or selecting examples, bear the following points in mind.

- The examples probably do more than anything else to define for the students what is required of them at the end of the course. So the balance of topics and skills represented should be thought out with great care.
- There should be a diet of descriptive questions or parts of questions, with encouragement to tackle them. Being forced to explain the ideas in the course is an important part of the learning process, and many students have far to go in making themselves clear on paper, especially in the first year.
- There should be a diet of introductory structured examples, designed to lead students by a succession of easy steps into using the new material. It is important, especially in the first year when students have little experience of having to think for themselves, not to be demoralising and to allow the weaker students to make progress.
- There should also be a diet of examples which teach students to think things out for themselves. This is most appropriate in the second and third year core courses. In the first year it must be introduced gently. Remember that the fourth year Part III option courses are not graduate courses: we are aiming at general understanding of the ideas, rather than professional technical mastery of them.
- If 'hard' questions, or parts of questions, are clearly marked as such, students will be less dismayed if they can't do them and more pleased with themselves if they can.
- Questions should regularly involve real experimental data (in graphs and tables) and discussion of measurement techniques. In all courses, and especially in the first year, questions should from time to time require students to handle error estimates appropriately.
- Numerical answers should be given at the end of the sheet. You should also consider providing a few hints at the end of each question, or at the end of the sheet.
- There should be a sprinkling of Tripos questions, marked as such, which include 'quickie' short questions (type A) and descriptive 'essay' or 'write brief notes' questions (type B), as

well as traditional problem questions (type C). It is also good practice to provide a list of relevant Tripos questions at the end of the sheet; this provides extra educational material for the students.

- The TC encourages the inclusion of examples which are not directly related to preparation for Tripos exams, but which are intended to broaden the students' appreciation of the subject. These may require data analysis and presentation, or perhaps the use of MatLab to obtain a numerical solution.

It's essential to work through every question in detail yourself before you issue the examples.

The Teaching Committee has agreed that worked answers to all problem sheets, for all Tripos Parts, should be provided to students at the end of the course. It is also very helpful to have solution sheets available earlier, as an aid for supervisors. It is possible to post solutions on the TiS, but to restrict access so that students cannot see them – ask Helen Marshall for guidance if you want to pursue this. While the TC understands the risks inherent in this approach, it recognises that *unofficial* copies of solutions circulate among students anyway, and it is concerned to ensure that at least such solutions faithfully reflect the lecturer's intentions and expectations. Equally, it is becoming increasingly difficult to recruit supervisors, even for Part I, and the provision of a set of worked solutions makes this much easier.

6.7 Supervisions

Supervisions in Parts IA and IB are the responsibility of the colleges. They may be given by Fellows who are staff members in the Department, or, more commonly now, by graduate students. In either case, they are likely to follow a similar pattern, with students attempting typically six problems a week, and handing in their work to their supervisors for marking a day or so before the scheduled supervision. They are typically supervised in pairs for the first two years, which leaves plenty of time for going over the problems, and leaves some left over to deal with more general concerns.

Supervisions in Parts II and III are organised directly by the Department, albeit that students will be allocated to supervisors from their own colleges, where such exist. In Part II, supervisions are in threes (normally), with typically four supervisions for a 20 lecture course. Students will still work mostly from the problem sheets, but there is less time available for detailed solution of all problems, or for dealing with individual students. Part II lecturers are expected to take the lead in recruiting supervisors for their courses, and for checking that they are suitably prepared.

The Part III Topics courses are relatively specialised. Lecturers are responsible for determining the form of learning support to be provided, be it supervisions (perhaps in larger groups), examples classes, or seminars. Where lecturers require assistance in delivering this support, they are entirely responsible for recruiting the necessary supervisors, demonstrators etc.

6.8 Interaction with supervisors

Effective liaison between lecturers and supervisors is important. Lecturers of third and fourth year courses should normally do some supervising of their own courses, and will be expected to help in recruiting suitable supervisors and in making sure that supervision standards are maintained. It is helpful for lecturers to organise meetings with supervisors, including one meeting soon after the course starts at which the teaching aims of the course will be explained. Naturally, supervisors should be able to tackle the lecturers' examples, but nevertheless assistance and worked answers

should be freely provided to supervisors in a timely fashion, because this can save unnecessary labour and indicate the level of answer expected. Liaison with supervisors will probably give your first feedback on the success (or otherwise) of your course, in time to adjust if necessary.

In Part I, such close interaction with supervisors may be less appropriate, but lecturers must still be willing to respond efficiently and constructively to enquiries from supervisors.

6.9 Feedback

The chief sources of feedback are the end-of-course questionnaires and the Undergraduate Consultative Committee minutes, both of which are communicated automatically to lecturers. The Teaching Committee reviews the questionnaire responses each term, and if your course needs attention detailed assistance and guidance will be provided. During the year, there are the teaching staff meeting, and the meeting of Directors of Study and supervisors.

The problem with all of these sources of feedback is that they come too late to have any effect on the current course. For new lecturers, or a new lecture course, it is therefore essential to get early response from someone after the first week or two, perhaps from colleagues who are supervising your course, from your own supervisees or by asking the class directly. New staff will of course also receive feedback from their 'mentor'.

We all discover that questionnaire responses are sometimes unreasonably caustic or may seem very variable, and you may be tempted to ignore them. It depends, however, on the question. If a third of the class find you a bit fast and a third want you to speed up, you probably have your speed about right. But if a third of them say they can't hear, or say it's boring, you need to take some action, whatever the rest may think.

Don't be put off by rude responses. It is not uncommon to hear the fourth year students on the Consultative Committee lecturing the first years on why some particular course was good for them, even though they didn't like it at the time!

7 Supervising

Supervisions are small group teaching sessions which are paid for by the colleges. They usually last for an hour at a time, and supervisors might expect to see each student for anything from four sessions each (Parts II and III) to 24 sessions (Parts IA and IB). Most Part I supervisions are organised by the colleges. Supervisions for Part II, Part III and the Mathematical Methods course in Part IB, are still paid for by the Colleges, but are organised by the Department (currently by Rachael Padman—rp11@cam.ac.uk). Towards the end of term you should claim payment from the students' colleges through CamCORS, the Cambridge Colleges On-line Reporting System[14]. You will need to write a short report on each student; this provides important feedback to the students and their Directors of Studies and Tutors. It is useful to keep notes on individual students' performance throughout the term: these can usefully be saved as draft reports in CamCORS.

[14] http://www.camcors.cam.ac.uk/

If you don't already have a CamCORS account, please consult Helen Marshall in the Teaching Office (teaching-office@phy.cam.ac.uk).

The University runs courses on 'how to supervise'. If you are asked to supervise for the Department, make prior contact with the lecturer for briefing on the aims of the course, and how the lecturer's examples should be tackled.

In Pt I and Pt II, where supervision is in small groups of two or three, there are various basics to remember.

Reading: Take time early on to discuss books and reading.

Written work: You *must* set appropriate written work to be done for each supervision. This will usually be centred on the lecturer's examples sheet.

Old Tripos questions are also a valuable resource for supervisions. Your choice has a major effect on the students' progress. Be sure that you know the course synopsis and decide in advance what are the key points; you won't have time to cover everything.

Individual attention: The chief point of small group supervision is to attend to the *individual* needs of students; so you have first to find out what their individual needs are, and then to meet them.

Preparation: For small group supervisions up to the end of Part I you must read and mark students' written work *before* the supervision. It helps them much if you grade it with a `class', and write detailed comments on the script. For Part II, while it is still necessary to read the work, to ascertain the areas in which the students will need the most help, it is rarely sensible to mark it in detail. Instead, it is sufficient to give short hints, or encouragement. It is essential however that you then provide the necessary guidance in the supervision.

Decide in advance what area you would like the supervision to cover, and remind yourself of the key points. But be prepared to be flexible, because the students may have their own agenda.

Checking on progress: Ask them to tell you their difficulties. If you don't get much response, be prepared to ask them questions until you find where there are gaps. *Then* you can start explaining. Don't come with a prepared lecture; a good supervision involves the students doing some, or even much, of the talking. Be prepared to go very slowly with weak students and to stretch bright ones. Never bluff. If need be, note down the question and answer it next time.

Unresponsive students: If you have a lively student in a group it is only too easy to neglect the quiet ones. Be sure to bring them all forward; if necessary, alter the groupings.

Friendliness: Never be scathing. Be firm about lack of work, but try to find what lies behind it. Build up confidence. Spend a little time finding out their aspirations. If you suspect that things are going seriously wrong, tell the college DoS sooner rather than later.

Also resist the opposite temptation. Your relationship with your students should be professional. While they may – because they know you – ask you for advice on personal or pastoral issues, it is usually best to refer them to their Director of Studies or Tutor, or to other sources of advice as appropriate.

Sexual harassment: In small group teaching, students may be more sensitive than you realise. Make sure they all have as much personal space as they seem to want. Sometimes, it might be better to avoid having everyone sitting side by side at a table.

The opposite situation can also occur, where a student's behaviour makes you, the supervisor, uncomfortable. Be firm in indicating the boundaries of acceptable behaviour. If unwanted behaviour continues, feel free to consult with the Supervisions Coordinator (currently Rachael Padman, rp11@cam.ac.uk), the Secretary of the Teaching Committee (David Green, dag9@mrao.cam.ac.uk), or the student's DoS or Tutor, as you see fit.

Feedback to students: It's important to keep a record of the students' performance. In your end-of-term report on CamCORS, go over their strengths and weaknesses, tell them your estimate of exam results, and lay definite plans for vacation revision. (This can be difficult in the 19 lines allowed – if you need to say more than this, consider an email to the Director of Studies.) Try to make your report illuminating both for the student and for the Director of Studies. The Department has sometimes been criticised by Colleges and by the University Applications Committee (which considers hard cases where students have had medical or psychological problems) for not giving adequate information in supervision reports.

Part II and III supervisions are unavoidably in larger groups where it may not be feasible to mark and discuss written work every week, but it is still important to set work and to assess progress, for instance by asking about difficulties, probing in general discussion, or perhaps by making them work at the blackboard or asking for self-assessment. Try at least to find out enough about their progress to be able to write your end of term report with conviction.

Students are invited to leave constructive feedback on the TIS on how they have found your supervisions. This is seen by the Supervisions Coordinator, and potentially the Chairman and Secretary of the Teaching Committee, and will be released to you provided it does not contain offensive or otherwise unacceptable comments.

8 Practical and Examples Class Teaching

8.1 Aims of Practical Classes

The Department has defined the aims of practical class teaching as:

- to introduce students to and to help them engage with experimental physics;
- to expose students to the role of experiment in the development of physics;
- to teach students how to approach an experimental study;
- to provide practice in using equipment, in gaining manual dexterity and in the handling of real data;
- to reinforce lecture material, where possible.

In all classes this will include: developing manipulative and observational skills; gaining experience of new types of apparatus and procedures; planning and recording observations correctly; making proper use of graphs for analysis and presentation of results; using computers in collecting and ana-

lyzing data; assessing and analyzing experimental errors correctly; learning how to draw valid conclusions from data; and developing the ability to write clear reports of experimental work.

Some classes will also have the specific aims of developing an understanding of analogue and digital electronics; of experiencing in the laboratory phenomena discussed in current lectures; of working in teams; of communicating and presenting the outcome of research; and, in Part III Project work, learning how to plan an experiment from scratch and how to design and build apparatus.

8.2 Aims of Examples Classes

All examples classes involve getting practice in certain skills. Most classes centre on problem-solving, and have the aims of:

- developing and practising specific problem-solving skills;
- developing ideas introduced in lectures by solving related problems;
- developing power and expertise in approaching and solving previously unseen problems.

Different classes are devoted to different aspects of these aims, such as developing expertise in mathematics or theoretical physics, learning how to programme a computer to tackle a specific problem, or revision of lecture course material.

8.3 Teaching Committee organisation

The Teaching Committee is responsible for setting the educational objectives of the various classes, and will allocate staff to them.

8.4 The Overall Head of Class

For every class there is an Overall Head of Class in general charge, who is responsible both for the management of the class and, in negotiation with the TC, for the teaching strategy. (In some classes this job is shared.) The job of Overall Head of Class requires a willingness to take strong initiatives and considerable determination to make the class a lively centre of effective teaching. In most classes there will also be Day Heads of Class (or just “Heads of Class”), who are in charge of the class on the day concerned.

The Overall Heads of Class have the following duties:

Aims and objectives: The identification, in consultation with the other staff attached to the class and with the teaching committee, of clear teaching targets.

Liaison: Discussing with relevant lecturers how the class material should be integrated with lecture material.

Development: Organising the development of new teaching methods and materials (experiments, examples, etc) which may be needed to achieve the teaching aims.

Class Manual: Publishing the Class Manual and any other printed material needed by the students. Effective revision of the Class Manual when necessary.

Coordination: This includes the allocation of Heads of Class and demonstrators to particular class sessions and preparing written instructions for them on the running of the class.

Training: Organising training sessions well before the class starts, and ensuring that other staff and demonstrators are thoroughly familiar with the experiments or examples, know what they are expected to do during the sessions, and ready to pursue the aims of the class with enthusiasm.

Marking and moderation: Note particularly that Overall Heads are responsible to the Head of Department for marks transmitted to the Examiners. They must ensure that all staff understand thoroughly the scheme of assessment, and must set up and run correctly an appropriate scheme of moderation of the marks awarded by Heads of Class and demonstrators.

Finance: Responsibility for class expenditure, and authorising demonstrator expenditure following guidelines from the Teaching Committee and in collaboration with the Chair of the Teaching Committee. Negotiation with the Teaching Committee over any major non-recurrent expenditure.

Safety: Responsibility for class safety procedures, and for carrying out and regularly updating risk assessments as required by the Departmental Safety Officer, currently Jane Blunt (fjb27@phy.cam.ac.uk), and bringing these to the attention of the DHCs and demonstrators.

College feedback: Responsibility for ensuring that Colleges are given early warning of persistent non-attendance by students.

The Overall Head of Class is normally also expected to act as one of the Day Heads of Class.

8.5 Day Heads of Class

If you are a Head of Class, your Overall Head will brief you on the aims and organisation of the class and your duties. The Head of Class must be an effective and lively organiser and teacher. In all classes, Heads of Class have the following duties.

Familiarisation: Heads of Class will be expected to spend some time doing the experiments or working through the examples themselves prior to the classes. Each Head of Class must understand what the objectives of the class are, and be determined to be proactive in attaining them.

Briefings: in most classes, the pace on a given day will be set by briefings and postmortems, at various stages, given either to the whole class by the Head of Class or by demonstrators to smaller groups of students. The liveliness and effectiveness of the class will depend very much on these briefings, and Heads will be responsible for ensuring that they are carefully prepared and carried out effectively.

Accessibility: the Head of Class and other Staff Members must be visible and approachable for the whole of the teaching period. It is permissible to be absent for a short period for a lunch or tea break, but for safety reasons, when this happens an effective deputy, who understands clearly that he or she is responsible for safety, must be present *in lieu.*

Proactive teaching: each Head of Class must set an example by spending a substantial part of the session talking with students individually, helping them and generating enthusiasm.

Supervision of demonstrators: see below.

Equipment: nothing saps morale more than equipment which does not work. All Heads of Class must be proactive in removing faulty equipment from the class and getting it repaired by the assistants in the class.

Marking and moderation: it is up to the Head of Class to ensure that whatever marking takes place in his or her class is done accurately and fairly, according to the plan set up by the Overall Head. There must be a well-controlled scheme for moderating marking by demonstrators.

Safety: the Head of Class is responsible for class safety on the day concerned, and must brief students clearly on any safety issues relevant to the day's class.

Progress records: in classes which are assessed for credit in Tripos, the Head of Class is responsible for ensuring that appropriate records are kept accurately, and for reporting in good time to Colleges, through the Overall Head, whether any of their students are persistently missing classes.

Development: Heads of Class should take an active interest in the development of the class, and may be asked, for instance, to take charge of a particular experiment, to develop new experiments or new examples, or to revise parts of the Class Manual.

If you are not sure about how these duties should be interpreted in your particular class, consult your Overall Head.

8.6 Demonstrators

Demonstrators are usually research students, and they receive a modest payment for their work in the classes. They will have received some initial training in teaching styles and assessment. Some of them will inevitably be inexperienced, and they will certainly need further instruction in the operation of the class concerned.

We also employ, in some classes, a small number of *Senior Demonstrators*. These are established postdocs, who take some responsibility for the training and organization of other demonstrators: they are paid a higher hourly rate in recognition.

The following points should be noted, and are the responsibility of the Heads of Class:

Training: there must be a training session before the class starts at which demonstrators practice the experiments or examples which the students will do. Their work should be carefully marked, with clear feedback. They must also be trained in exactly what is expected of them during the class sessions, and in how to interact with the students. They must be instructed exactly in whatever assessment system is used in the class.

Team spirit: the success of the class depends on the class demonstrators, and it is up to the Head of Class to ensure that they are properly trained and to get them working as a lively team; with inexperienced demonstrators this may not be easy. It is absolutely essential that the whole team makes frequent and friendly contact with the students, and that everyone is active in instruction. Every student must be encouraged.

Supervision: demonstrators must be firmly supervised. Proper timekeeping is important. Trained substitutes must be arranged if absence is inevitable. The need to be always accessible to students and proactive in teaching must be emphasized, but is perhaps best demonstrated by example.

Heads of Class must be ready to correct unhelpful attitudes: demonstrators must be friendly and encouraging to all students, and free of gender or other bias.

Assessment: if demonstrators assess work, it is important that they also provide effective feedback by writing comments on the work. Low or high marks should be explained. The OVERALL HEAD OF CLASS must develop an effective procedure for moderating the marking of demonstrators.

8.7 Class assistants

The class assistants will usually have the following duties.

Equipment: to make sure that the required equipment is available in the right quantities, to organize repairs and order replacements or new equipment when required. To check the safety of equipment under the guidance of the safety officer. To safeguard and keep safely any dangerous materials needed for the classes.

Tidiness: to ensure that the classrooms and laboratories used for any classes are clean, tidy and safe.

Administration: to (usually) deal with accounts, and maintain formal records of marks.

Harry Druiff[15] is in overall charge of the class assistants and concerned with their career development. Please be sure to discuss with him such things as assistants' workloads, training, difficulties, or any particularly good work.

8.8 Part II Experiments

The experiments in Part II are longer and differently organised. Students may opt to do one or two experiments. Dave Ritchie (dar11@cam.ac.uk) runs the class as a whole, but the individual experiments are organised by the various research groups in the department, on topics related to their research, with a particular staff member in charge of each experiment. The students' appreciation of physics as a challenging experimental discipline depends largely on the topicality and liveliness of these experiments. The detailed arrangements are set out in the Part II Class Manual, and most of the principles set out in previous subsections apply, but staff should note the following points in particular.

- Students should be given a thorough introductory briefing by the staff member in charge.
- The staff member or some deputy *must* be available for consultation during the whole period of the experiment. The staff member or deputy should visit the class regularly, and be reachable by telephone at other times.
- The staff member should check progress with each student, with a review at the half-way stage.
- The staff member will mark the experimental write-up according to the agreed marking scheme, and will discuss it thoroughly with the student.
- Since students will be less closely supervised than in earlier experiments, they must be thoroughly briefed on safety issues, and a written safety notice must be prominent. Appropriate assistance must be on call at all times.

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9 Projects and Research Reviews

Many students do a Research Review in Part II, organised by Malte Grosche (fmg12@cam.ac.uk), and all do a Project in Part III, organised by Charles Smith (cgs4@cam.ac.uk). All staff are expected to suggest review and project topics which they would be willing to supervise. The supervision of a Part III project is paid for by colleges, as the equivalent of six ordinary supervisions, and a Research Review as the equivalent of two supervisions. This payment is primarily for feedback, monitoring and mentoring; you may well invest significantly more time in the project, and this is regarded as a Departmental teaching duty. It is acceptable for the day-to-day supervision to be carried out by one of your postdocs (if sufficiently skilled), and if this is the case, they should be claiming the supervision payments rather than you. Whatever the arrangement, as a member of staff, you are still officially the supervisor, and have responsibility for the overall conduct of the project, from both a safety and academic point of view.

Detailed instructions are issued by the organisers, but please note the following general points.

Planning research reviews: The body of literature chosen must be neither too large nor too small. It should also be stretching, but within the capacity of the student to understand.

Planning projects: The topic should be a genuine small piece of research. This of course makes it hard to be sure that it can be done in the time available. The work must be scheduled and equipment must be made available in good time. Escape routes should be available if something doesn't work, or doesn't work quickly enough.

Communication skills: In both Research Reviews and Projects, students have to make oral presentations to a group of peers, during the Lent Term, to prepare written Reports, and to defend their Reports in an Oral Examination. As well as encouraging the obvious research skills, the supervisor has a vital role in teaching and encouraging communication skills, both written and oral. So time must be spent on discussing outlines and drafting style, and commenting on oral presentations.

Assessment: Research Reviews and Projects contribute substantially to the Tripos assessment. Keep half an eye open for cheating (by plagiarism, for instance), and take seriously your part in making the final judgement.

For Part III projects in particular, the supervisor's input is critical to the assessment. If you take on supervision of a project, you *must* commit to being available for a viva (around 1 hour) in the relevant period in the middle of the Easter Term. If you are not able to participate in the report and viva, the student may be seriously disadvantaged.

Students' attention can usefully be drawn early on to the Department's plagiarism policy, at http://www.phy.cam.ac.uk/teaching/plagiarism.php

Safety: Part III project students will be working in real research labs, and often doing real research: they are likely to be exposed to real safety hazards. It is the responsibility of the supervisor to complete a risk assessment for each project, and to discuss hazards with the student: no student will be

permitted to start work in the lab until they have been appropriately trained in dealing with the hazards.

Where a student will be working in a laboratory in another department, s/he is expected to comply also with any procedures that department may require: please let the Teaching Office know that this will be the case, so that Helen Marshall can formally notify the other department of the presence of one our students.

10 Examining

Examiners are proposed by the Head of Department and appointed by the General Board's Education Section. While they are technically independent of the Department, they are subject to direction by the Faculty Board: since multiple Faculties contribute to the Natural Sciences Tripos, the NST Committee of Management has powers equivalent to a Faculty Board, and for Parts II and III delegates these powers substantially to departmental teaching committees, whilst retaining the power of oversight. This means, in effect, that the Teaching Committee is responsible for deciding on the Form and Conduct of the Examinations, and for promulgating any changes thereto.

Examiners have to examine in accordance with

- the Statutes and Ordinances governing examinations in general and those governing the NST;
- the current *Supplementary Regulations* which describe the forms of the Papers (any amendments must be agreed by the TC, and approved by the NST Committee before the start of the Michaelmas Term);
- the formal guidelines from the Department, which cover such things as preparation of questions, mark schemes and model answers; the extent of double marking; rules for what must and must not be written on scripts (and other consequences of the Data Protection Act), moderation of marks for coursework; scaling of marks; anonymity of candidates; printing and security of papers; role of External Examiners; guidance on classing etc.

It is particularly important that all examiners have read and understood the formal instructions.

Each body of physics examiners is chaired by an appointed Senior Examiner. Work normally begins in earnest about Christmas time (but earlier for Part III). In Parts IA and IB the physics examiners form part of a larger body which will meet to set procedures and to fix the final class list. In Parts II and III, though technically still part of a larger body, the physics examiners meet and prepare their class lists alone, with the help of two External Examiners. In Part III, the various option lecturers are appointed as assessors, and are expected to set and mark questions, though the examiners still scrutinise the questions.

At certain stages, time is very tight, and it is vital that examiners complete all their tasks at the correct time, and attend all meetings. Absence from the final meeting requires the permission of the Vice-Chancellor, and is only granted in exceptional circumstances.

11 Student welfare and college liaison

The chief responsibility for the welfare and progress of students lies with their Tutor and Director of Studies in college, but the Department also has a number of responsibilities.

We organise an induction meeting for students at the start of each year of the course. There are also notice boards for each year on which information about examinations and other matters important to students are displayed, and, increasingly, we use the TiS to email specific year groups with information about their courses.

There must be effective and systematic liaison with the college whenever we have evidence of poor progress, such as poor marks in or absence from classes, or poor work in supervisions. Informative supervision reports are important to Directors of Studies. Effective liaison is also important if a student is unhappy, sick or in trouble of any kind.

We also aim to keep colleges well informed about teaching matters. With the help of colleges, the Teaching Office maintains e-mail lists of Directors of Studies and all physics supervisors. There is an annual meeting for Directors of Studies and supervisors at which issues can be aired.

The safety of students is governed by the Safety at Work Act. This is a particular responsibility of the Departmental Safety Committee, but all staff, especially those concerned with practical classes and project work, have a duty to keep students safe, and to encourage students themselves to take safety seriously. Undergraduates must not undertake practical work out of hours, or without help being within call.

The Department supports the undergraduate Physics Society (CUPS). Students are encouraged to attend Cavendish Physical Society lectures and are generally welcome at research seminars. Formal careers advice is provided by the Careers Service, but staff members should ask students about their career plans and should give informal advice where they can. This is particularly helpful for students who wish to move on to graduate research.

The Department wishes to encourage more women to take and stick with physics, and supports women's group activities.

Students should be encouraged to report any form of discrimination or harassment. Two staff members – Dr Bill Allison, wa14@phy.cam.ac.uk, and Dr Julia Riley, jmr2@cam.ac.uk – have been appointed as first contacts within the department for any student who believes s/he has been, or is being, subjected to such discrimination or harassment.

And finally…

It is not illegal for academic staff to conduct relationships with students, and indeed it is impossible to prevent this occurring, no matter how unwise it may be. If you do form such a relationship, it is essential that you protect both yourself and the student by declaring it to relevant parties, so that arrangements can be made for someone else to take over your teaching responsibilities for the student. It would probably be best to approach the Deputy Head of Department (Teaching) or the Chairman of the Teaching Committee in the first instance.