UNIVERSITY OF CAMBRIDGE

Cavendish Laboratory

Physics Course Handbook 2022/23

Architect's rendering of the entrance of the Ray Dolby Centre, the 3rd Cavendish Laboratory, which we expect to occupy from 2023/24. Credit: Jestico & Whiles architects

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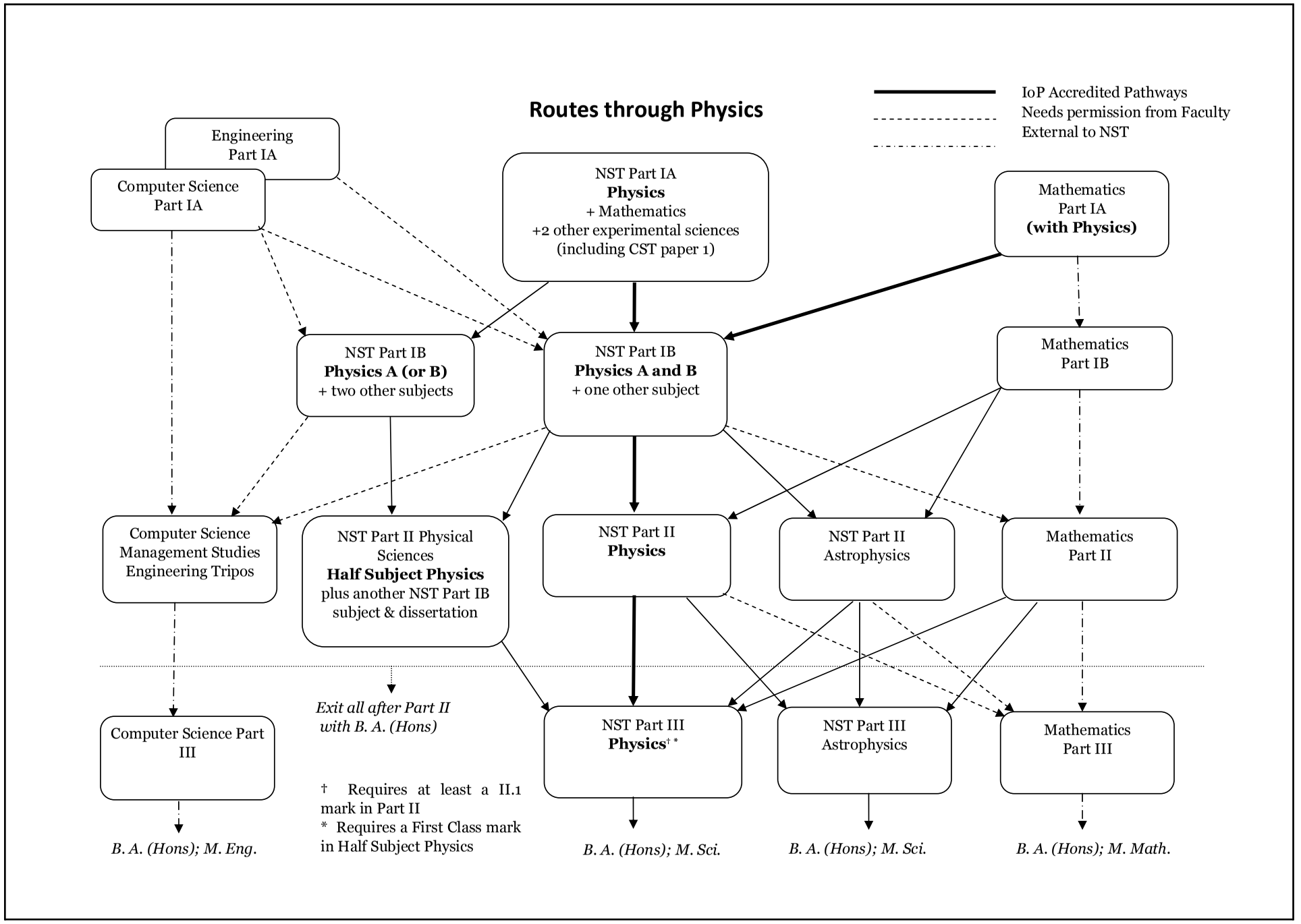
Routes through Physics
IoP Accredited Pathways
Needs permission from Faculty
External to NST
Engineering Part IA
Computer Science Part IA
NST Part IA
Physics
+ Mathematics
+2 other experimental sciences
(including CST paper 1)
Mathematics Part IA
(with Physics)
NST Part IB
Physics A (or B)
+ two other subjects
NST Part IB
Physics A and B
+ one other subject
Mathematics Part IB
Computer Science
Management Studies
Engineering Tripos
NST Part II Physical Sciences
Half Subject Physics
plus another NST Part IB subject & dissertation
NST Part II
Physics
NST Part II
Astrophysics
Mathematics Part II
Exit all after Part II with B. A. (Hons)
Computer Science Part III
NST Part III
Physics† *
NST Part III
Astrophysics
Mathematics Part III
† Requires at least a II.1 mark in Part II
* Requires a First Class mark in Half Subject Physics
B. A. (Hons); M. Eng.
B. A. (Hons); M. Sci.
B. A. (Hons); M. Sci.
B. A. (Hons); M. Math.

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- For the latest version of this Course Handbook and up to date information about lectures, practicals and exams, please consult the main Cavendish Laboratory undergraduate web pages: http://www.phy.cam.ac.uk/teaching. More teaching information can be found on the webpages listed in section 2.1
- The Cavendish Laboratory's **Undergraduate Office** is situated in the Bragg Building, Room 179. Helen Marshall, Senior Teaching Administrator, and can be reached at undergraduate-office@phy.cam.ac.uk
- The Director of Undergraduate Education is Prof Ulrich Schneider, uws20@cam.ac.uk; please send any suggestions for improvements or corrections to this handbook to him.
- This handbook aims to describe the course for the year 2022/23 as accurately as possible but please note that **information can evolve during the year**. Furthermore, while the core of the course is very stable, the availability of some lectures, in particular more specialist ones, can change from year to year.
- **While we are currently not expecting any restrictions due to COVID and are planning to offer almost all teaching in person, this might have to change during the year.**

1 Welcome to the Cavendish

Welcome to the **Cavendish Laboratory**, the home of the Department of Physics in the University, and to this guide to our undergraduate courses. The laboratory comprises a large and diverse community of research staff, teaching staff, students and support staff, and we want everyone to feel welcome and able to thrive, whatever their role, in a supportive environment. Our **Cavendish values** underpin this goal:

Consideration - *treating others as we would like others to treat us*

Respect for all - *showing respect for each other*

Helping others to excel - *actively seeking ways to enable everyone to give their best, regardless of their personal circumstances*

Supporting career aspirations - *encouraging and supporting everyone in pursuing their career aspirations*

Recognising contribution - *recognising everyone's contribution to the Department's success*

We expect every member of our community to uphold these values, and contribute to making the laboratory a great place for everyone to study and work.

The current physical home of the laboratory, the "Cavendish II" buildings, were built in the early 1970s to replace the original 1874 Cavendish Laboratory on Free School Lane in the city. The construction of a new laboratory, the Ray Dolby Centre (part of Cavendish III), to replace the existing buildings has recently begun on the old Vet School paddock site on JJ Thomson Avenue. This building should be complete in 2023 and will eventually house all the educational and most of the department's research activities.

2 Undergraduate Courses in Physics

2.1 Introduction

The Department of Physics offers both three- and four-year courses in physics, which form the two basic routes to a first degree with specialisation in physics.

- The four-year "integrated Masters" course is designed for students who wish to pursue a professional career in physics, for example, in academic or industrial research: it leads to an honours degree of Master of Natural Sciences, M.Sci., together with an honours degree Bachelor of Arts, B.A.
- The three-year course is designed for students with a deep interest in the subject but who may not intend to become professional physicists: it leads to an honours degree of B.A.

The decision of whether to leave after three years or to continue into the fourth year will be taken at the end of the third year - see later for details. Physics graduates from Cambridge go in a wide range of directions. As many as a half of our graduates embark on research leading to a higher degree, and about a quarter go straight into full-time employment in a wide variety of fields, such as teaching, business and finance, and computing. The remainder are spread over other types of postgraduate activities. Our graduates have an excellent record of finding employment promptly after graduation.

As regards research towards a Ph.D., at present the policy announced by the UK Research Councils is that an Upper Second or First Class in either the third or fourth years formally qualifies a student for a Ph.D. award. However, the policy of this Department and many others is that Part III is an essential preparation for a Ph.D.

In both the three and four year courses our aims are to provide a solid foundation in all aspects of physics and to show something of the very broad spectrum of modern physics. Vital basic areas such as Electromagnetism, Quantum Mechanics, Dynamics and Thermodynamics are covered in the first three years, where we also aim to develop experimental, computational and mathematical skills. Advanced work in the fourth year can include fundamental subjects such as Advanced Quantum Theory, Quantum Optics and Quantum Information, Particle Physics, Condensed Matter Physics and Cosmology as well as applied topics such as Biological Physics and Geophysics. A substantial piece of independent project work is required in the fourth year, and there are also possibilities for experience of industrial research during the long vacations.

In the following sections, brief descriptions are given of the undergraduate courses currently offered by the department. The flow chart inside the front cover shows routes through the three- and four-year courses. The detailed synopses for all the courses to be delivered in the academic year 2022-230, as well as their aims and outcomes can be found on the course website in the TIS (see below).

Students are reminded that their **Director of Studies in college is their first point of contact for advice on academic aspects of their studies**, in particular regarding their choice of courses; nonetheless, the Director of Undergraduate Education will be happy to discuss such choices if needed.

The **Undergraduate Office** is situated on the ground floor of the Bragg building, Room 179, tel. 65798. The office is run by Helen Marshall and is open for general enquiries at regular times during full term. Helen can also be reached on MS Teams.

Routine administrative matters regarding the course should be addressed to the Undergraduate Office via Teams, via undergraduate-office@phy.cam.ac.uk, or in person, but please check first that your question is not answered in this handbook or the on the course websites.

The Director of Undergraduate Education in Physics is Prof. Ulrich Schneider; he can be contacted at uws20@cam.ac.uk. If you still have unresolved issues, you can contact the Chair of the Staff-Student Consultative Committee, Dr Melissa Uchida mau24@cam.ac.uk and the Head of Department, Prof. Andy Parker.

Several websites support our Physics courses:

1. The main public webpages for undergraduates are at `https://www.phy.cam.ac.uk/students/teaching` and contain for instance up-to-date versions of this guide and links to useful materials (e.g. TIS, examination timetable, exam format).
2. The Teaching Information System (TIS or TiS) is a Cavendish-developed system that is used to administer all of our courses. In particular it serves course synopses, handouts, and examples sheets for all the courses and beyond, plus past examination papers in Physics. Its web address is `http://www-teach.phy.cam.ac.uk/` and access requires your CRSid and Raven authentication.

3. The University's online timetable tool (http://timetable.cam.ac.uk) allows you to create your own timetable of lectures and practicals, and add to your own electronic calendar.

4. The University's Moodle Virtual Learning Environment (VLE: https://www.vle.cam.ac.uk) is hosting all recorded lectures and in some cases additional material. You will be auto-enrolled to your courses on Moodle after your registration on the TIS.

2.2 Course Overview

2.2.1 The First Year (Part IA)

Students in the first year of the Natural Sciences Tripos (NST) choose three experimental subjects, plus a mathematics course; see http://www.natsci.tripos.cam.ac.uk/.

The Part IA Physics course assumes either A-level Physics (or equivalent), or A-level Further Maths (including the Mechanics modules). Ideally students would have done both Physics and Further Maths, but this is not essential.

The first-year course, Part IA Physics, covers fundamental principles in physics. The aim is to bridge the gap between school and university physics by providing a more complete and logical framework in key areas of classical physics, as well as introducing new areas such as relativity and quantum physics. The Part IA Physics course is given in three lectures per week plus a four-hour experiment once every two weeks. Subjects studied include Mechanics, Relativity, Oscillations and Waves, Quantum Waves, and Fields.

It is also possible to read Part IA Physics as part of the Mathematical Tripos in the first-year course 'Mathematics with Physics'. Both of these routes provide for possible specialisation in physics in later years.

There is no limit on the number of students. In 2020/21, there were 371 students reading Part IA Physics.

2.2.2 The Second Year (Part IB)

There are two physics courses in Part IB: Physics A and Physics B. Physics A provides a grounding in optics, quantum mechanics and solid-state physics, while Physics B covers the core of classical physics, including electromagnetism, dynamics and thermodynamics.

The majority of students choose to study both physics courses: the combination of Part IB Physics A **and** Physics B offers a firm grounding in key areas of physics – theoretical and experimental – and covers specialised topics that lead naturally to Part II/III Physics and other quantitative subjects. Students taking both courses combine them with one other IB subject. This third subject is often NST Part IB Mathematics, and this is important for students wishing to pursue theoretical options in Part II Physics. However, choosing a different subject provides additional breadth and gives greater choice of Part II and Part III courses. Common choices for the third subject are Materials Science, Chemistry A, Earth Sciences A or History and Philosophy of Science.

Students taking *either* Physics A or Physics B *without NST IB Mathematics* will attend a course in Mathematical Methods, which has associated supervisions: this course covers some essential mathematical methods needed in the physics courses.

There is no limit on the number of students taking IB Physics A and Physics B: in 2018/19, 185 students took both; the majority of these proceed to take Part II Physics.

Students come into the combination of IB Physics A and B mostly having taken both Physics and Mathematics in Part IA of the Natural Sciences Tripos. Of those who have taken the first-year Mathematics with Physics course in the Mathematics Tripos, a significant proportion subsequently take IB Physics A and B.

A smaller number of students, usually ten to twenty, take IB Physics A as their *only* physics course. Part IB Physics A provides a self-contained package of quantum, condensed matter and experimental physics. It builds on Part IA Physics and offers a firm grounding in important areas of physics that is very useful for scientists with a wide range of career destinations. The students will normally take

two other Part IB subjects, and then go into a wide range of third-year courses. Note that **Part IB Physics A alone is not an adequate preparation for Part II Physics.**

It is also possible, **though unusual and normally not recommended**, for students to take IB Physics B as their only physics course, and this may suit students with a particular interest in the topics covered in that course. Note that **Part IB Physics B alone is not an adequate preparation for Part II Physics.** Further, the practical work draws heavily on material presented in Physics A in the Michaelmas Term: students taking just Physics B are advised to attend the Experimental Methods lectures for Physics A for necessary background. We expect that almost every student wishing to pursue a single physics course will find IB Physics A the more attractive option. Note that it is not normally possible to take Part IB Physics B with Animal Biology or Pharmacology.

2.2.3 The Third Year (Part II)

The aim of the third-year Part II Physics course is to complete instruction in core physics and to begin to introduce more advanced topics required for a professional career in research. The available courses cover a broad range of experimental, theoretical and computational subjects, with an element of choice that allows students to explore topics they find particularly interesting and, if they wish, to concentrate on more experimental or theoretical work. Professional skills are developed through lectures, example classes, computing exercises and extended experiments, depending on the courses taken.

In the Michaelmas term, there are four obligatory core courses in Advanced Quantum Physics, Relativity, Optics and Electrodynamics, and Thermal and Statistical Physics.

In the Lent and Easter term, students have some choice amongst lecture courses including Astrophysical Fluid Dynamics, Particle and Nuclear Physics, Quantum Condensed Matter, and Soft Condensed Matter. Additionally there is a short course on Computational Physics, with associated assessed exercises.

Students are also required to submit three or more items of “Further Work”. You may choose an experimentally-biased course or one with a stronger emphasis on theory, or some intermediate combination of experiment and theory. For example, there is the option of carrying out up to two experimental investigations (E1 & E2), each lasting two weeks. For those with an interest in theory, there are two courses in Theoretical Physics, consisting of lectures plus examples classes, which run through the Michaelmas and Lent terms. Other possible units of Further Work include: the Computational Physics project, the Physics Education course, and a Research Review.

There is no limit on the number of students taking Part II Physics, provided they meet the entry requirements (i.e. successful completion of Physics A **and** Physics B in Part IB). In recent years we have had about 150 students, the largest class in any Part II Natural Science subject.

An alternative for the third year is Half Subject Physics in Part II Physical Sciences of the Natural Sciences Tripos. This is offered to students who wish to retain an interest in physics but to keep other options open at the same time. They select about half the workload from the third-year physics course, combined with a Part IB subject which they have not previously taken, such as History and Philosophy of Science, plus a Dissertation. We expect that students offering Half Subject Physics will have read IB Physics A or Physics B in the second year. Advice on suitable combinations of Part II Physics courses can be obtained from your Director of Studies. Half Subject Physics is not an adequate preparation for Part III Physics.

2.2.4 The Fourth Year (Part III)

The fourth-year course, Part III Physics, is designed to provide the necessary foundation for a professional career in academic or industrial research. The course spans the spectrum from strongly experimental to highly theoretical physics and offers the flexibility for students to select a wide range of different combinations of subjects, according to their career aspirations. Many of the courses reflect major research interests of staff in the Cavendish. There is a substantial amount of independent project work, which may be proposed by the students themselves.

Our aim in the fourth year is to present physics as a connected subject of enormous flexibility and applicability. Lecture courses in the first and second terms provide more advanced treatments of major areas of physics and are selected to reflect broad areas of current interest. Many of them have an interdisciplinary character. Revision classes in general physics are given in the Easter Term and all students undertake a substantial project which is worth one third of the year's marks. The overall course provides excellent preparation for a research career inside or outside physics in either the academic or industrial sectors.

There is currently no limit on the number of places, but **a upper second class result or better in Part II Physics is required**.

2.2.5 Master of Advanced Studies (MASt) in Physics

This is a taught one-year postgraduate course, which consists of exactly the same content and assessment process as Part III Physics. This course is designed for students who hold a 3-year undergraduate degree and wish to pursue an additional taught Master's degree. The entry requirement for the MASt is a qualification comparable to an upper second class or better UK Bachelor's degree in Physics. Students from all over the world join us to take this course and the goal is that they integrate effectively with the Part III class. In 2020/21, there were 13 students taking the MASt.

2.3 Mathematics Courses

The mathematical skills needed by students who follow the three- or four-year physics course are quite varied. Students taking entirely experimental options may need much less sophisticated mathematics than those taking the more advanced theoretical options. The level of mathematics preparation at school is also variable. Some students entering Part IA Physics have studied both Mathematics and Further Maths at A level or equivalent, while others have studied only one A level.

The aim of the Physics Department is to challenge the most gifted and best-prepared students, while providing access to theoretical courses for those less well prepared. The Mathematics course for Natural Scientists in Part IA assumes only single Mathematics A-level.

In the second year, both IB Physics courses assume only mathematical material from NST IA mathematics. Other necessary mathematical techniques are taught alongside the physics or in NST Part IB Mathematics: for those not taking this course, there is a non-examined (but supervised) course in Mathematical Methods given in the Michaelmas Term. This covers all the mathematical material needed for the Part II core and options courses.

The optional theoretical courses in Part II (TP1 and TP2) prepare students for the theoretical options in Part III. Students intending to take TP1 and/or TP2, and who have not taken Part IB NST Mathematics, will find it helpful to do some extra preparation in the long vacation at the end of Part IB; they should seek advice on this from their Director of Studies or the course lecturers.

3 Aims and Objectives of the Physics Teaching Programme

3.1 The University's Aims And Objectives

The University's stated aims are 'to foster and develop academic excellence across a wide range of subjects and at all levels of study'. Furthermore, the University aims 'to provide an education of the highest calibre at both the undergraduate and postgraduate level, and so produce graduates of the calibre sought by industry, the professions, and the public service, as well as providing academic teachers and researchers for the future'. The broad aims of the Department of Physics are identical with these.

In the context of the Departmental teaching programmes, the specific aims and objectives are given below.

3.2 Course Aims

- To provide education in physics of the highest quality at both the undergraduate and graduate levels and so produce graduates of the calibre sought by industry, the professions, and the public service, as well as providing the academic teachers and researchers of the future;
- To continue to attract outstanding students from all backgrounds;
- To provide an intellectually stimulating environment in which all students have the opportunity to develop their abilities to the best of their potential, *regardless of their background*;
- To maintain the highest academic standards in undergraduate and graduate teaching and to develop new areas of teaching and research in response to the advance of scholarship and the needs of the community;
- To encourage and pursue research of the highest quality in physics, and maintain Cambridge's position as one of the world's leading centres in these fields.
- More detail can be found in the **Physics core competencies** statement of the department, available at https://www.phy.cam.ac.uk/system/files/documents/copy_of_Physicscorecompetencies.pdf.

3.3 Course Objectives

By the **end of the first year** (Part IA Physics), students, whether continuing with physics or not, should have:

- attained a common level in basic mathematically-based physics, and so laid a secure foundation in physics for their future courses within the Natural Sciences or other Triposes;
- acquired a broad introduction to a range of sciences at University level, generally through having studied two other experimental subjects as well as mathematics;
- developed their experimental and data analysis skills through a wide range of experiments in the practical laboratories and an introduction to scientific computing.

By the **end of the second year**, students taking Part IB Physics A and Part IB Physics B should have:

- been introduced to powerful tools for tackling a wide range of topics, including formal methods in classical and quantum physics;
- become familiar with additional relevant mathematical techniques;
- further developed their experimental skills through a series of whole-day experiments, some of which also illustrate major themes of the lecture courses, and developed their communication skills through group activities.

By the end of the second year, students taking Part IB Physics A should have:

- covered a wide range of topics in quantum and condensed matter physics with emphasis upon their practical applications and utility;
- further developed their practical skills through a series of whole-day experiments, some of which illustrate major themes of the lecture courses.

By the end of the second year, students taking Part IB Physics B should have:

- covered a range of topics in classical physics, including electromagnetism, dynamics and thermodynamics;
- further developed their practical skills through a series of whole-day experiments, some of which illustrate major themes of the lecture courses.
- have learnt to solve sophisticated physics problems using modern computational methods;

By the **end of the third year**, students taking Part II Physics should have:

- completed their study of core physics;
- substantially developed professional skills in experimental and/or theoretical and/or computational physics, or in Physics Education;
- had experience of independent work, including an introduction to aspects of research;
- had experience of the application of computers to physical problems;
- developed their communication skills
- had experience of independent work.

By the end of the third year, students taking **Half Subject Physics** in Part II Physical Sciences should have:

- enhanced their understanding of core physics, in the context of a broader exposure to science with the Natural Sciences Tripos;
- had some experience of independent work.

By the **end of the fourth year** (Part III Physics), students completing the four-year option should have:

- had experience of a number of broad areas of physics from a choice of options, taken to an advanced level, at which current research can be appreciated in some depth;
- carried out a substantial independent research project amounting to the equivalent of about six weeks of full-time work;
- maintained their skills in core physics;
- enhanced their communications skills;
- become well prepared for a career in academic or industrial research.

4 Course Accreditation, Quality and Student Feedback

We aspire to offer an outstanding education in physics to all of our students, who go on to a wide range of careers in science, technology and other areas. We are proud of our course and believe our graduating students leave Cambridge with an excellent in-depth knowledge of a great deal of physics, and with a very wide range of skills. There are numerous external and internal system in place to monitor our courses. Cambridge is a leading University, usually appearing near the top of global rankings, and our Physics course is highly regarded nationally and internationally. Although league tables should be taken with a pinch of salt, our Physics course scores very well, as can be seen for example in the Complete University Guide, which recognises our very able student intake, strong educational programme, student feedback, high research standing, and excellent career prospects for students after graduation.

4.1 Degree Accreditation and Examination Standards

Our degree course is formally accredited by the UK's Institute of Physics, which requires that a certain core curriculum of physics has been studied by our graduating class. Our course goes well beyond this core in most areas of physics. In Parts II and III, our two External Examiners, drawn from other leading UK Universities, help us ensure our courses and examinations are of suitable standard and quality, and help establish classing boundaries for degrees; you can read their detailed reports on the TIS.

4.2 University Oversight

Within Cambridge, the University's General Board assesses each degree programme via in-depth Learning & Teaching Reviews (LTR), every 5 years or so. An LTR in Physics took place in Lent 2018.

4.3 National Oversight: Office for Students and the NSS

The Office for Students (OfS) monitors degree-awarding bodies in various ways, but the one you will encounter is the National Student Survey (NSS), taken by students in their third year (Part II). Details can be found at http://www.thestudentsurvey.com/. This is an important survey for the Department and the University, allowing a synoptic view of the course and the student experience. The NSS results are discussed in detail at the Staff-Student Consultative Committee and the Teaching Committee; the Department uses the NSS to find areas where course quality and the learning experience can be further improved, and reports on its findings and changes made to the University.

4.4 National Oversight: The Teaching Excellence Framework (TEF)

The TEF is a new Government framework which monitors and promotes excellence in teaching in UK Universities. It uses metrics from the NSS and written University submissions to develop a picture of teaching and learning in each institution. The TEF has only just started operating, and will evolve over the coming years; the University currently holds a Gold award.

4.5 Student Feedback: the Physics Staff-Student Consultative Committee

Within the Department, we run regular questionnaires to monitor courses and student feedback, and have twice-termly meeting of the **Staff-Student Consultative Committee (SSCC)** where elected student representatives meet with course leaders and the Head of Department or his Deputy to discuss the courses and student feedback. These are particularly important meetings for the Department as they allow us to monitor student experience regularly and make improvements quickly where necessary and feasible. High-quality student feedback to the SSCC is highly welcomed by the department, and changes are actioned at the SSCC for implementation by the course leaders.

5 Working at the Cavendish Lab: access and safety

Teaching Laboratory Hours are: Mon, Tue, Thu, Fri - 09:00 to 17:45, Wed - 09:00 to 17:15, you will be notified which day and at what time your practical labs will be held. If you are attending a supervision in IA or IB in the department, please discuss access arrangements with your supervisor. See section 12 of this Handbook for further information about lab safety.

To report **EMERGENCIES call 37499** (see Emergency Notices located throughout the department)

6 Late Submission of Coursework

The Department of Physics expects students to meet the advertised deadlines for the submission of all coursework, to ensure fairness to all students taking the course and allow prompt marking by the Department.

In accordance with the University's regulations, **work submitted after the advertised deadline will not count towards your final examination mark, unless the Department grants an extension of time on the grounds that there are significant mitigating circumstances**.

Any application for such an extension should be made by your college Tutor and Director of Studies to the Director of Undergraduate Education, c/o Undergraduate Office, Cavendish Laboratory, (undergraduate-office@phy.cam.ac.uk). Students must complete the form available from the teaching webpages, including supporting cases from Tutor and Director of Studies.

In such circumstances, you should submit the work as soon as possible after the deadline.

Similarly, if you miss an agreed oral examination, you should complete the same form and ask your examiners if they would agree to a new viva date.

Your Part III Project makes up one third of total available Tripos marks, and is subject to special arrangements. Late submission of this report is a particularly serious matter, and will require your College to apply to the Examination Access and Mitigation Committee (EAMC) of the University to seek permission for any credit to be allowed. If this is not granted, the late work will not be counted.

7 Course Workload

There is no denying that Natural Sciences is a challenging degree course. Our own course in Physics leads, excitingly, in Parts II and III, to the frontiers of knowledge in physics, and to a degree of high national and international standing. The great flexibility of the Natural Sciences Tripos (NST) in the

first two years, the short teaching terms in Cambridge, and the broad nature of a degree in physics all contribute to the high workload for students especially during Full Term.

The Department, the University and the NST Management Committee are all mindful of the demands made on students, and publish guideline termtime workloads for the different parts of the course. In Parts IA and IB, NST guidelines suggest total workloads will be approximately 40 hours per week; and in Parts II and Part III Physics, we expect that students will typically need to work for 40-45 hours per week during full term. Successful students will plan to spend time between full terms to revise and consolidate the material taught during term, and, in later years, carry out project work.

If you are finding it difficult to manage your workload, you should in the first instance seek support from your Director of Studies (and/or Tutor) in college, who should be able to provide support and practical advice.

8 Part IA Physics

8.1 Aims Of The Course

An important objective of the course is to develop an understanding of core physics at successively deeper levels, each stage revealing new phenomena and greater insight into the behaviour of matter and radiation.

The first year of the course has several distinct aims. First, it aims to provide a firm foundation by bridging the gap between school- and university-level physics, and so bring students from different backgrounds to a common point, ready to start 2nd year studies. Second, it aims to consolidate school physics by providing a much more logical and analytical framework for classical physics, which will be essential for all years of the course. Third, it includes new themes such as special relativity and quantum physics, which foreshadow key topics to be developed in the subsequent years of the course. Fourth, the individual lecture courses aim to broaden your perspective, so that you can begin to appreciate the great flexibility and generality of the laws of physics and their application. And fifth, the experimental work is designed to developed your practical skills and prepare you for more advanced laboratory work in future years.

8.2 Induction

There is an **introductory talk at 10:30 on the first Wednesday of Michaelmas full term (Wednesday 5th October 2022)**. All students should attend this.

8.3 The Lecture Courses

The lecture courses are listed in the table below; detailed synopses are available online. Please check the course website for latest developments and contacts.

All IA Physics lectures take place in the Bristol-Myers Squibb Lecture Theatre, Chemical Laboratory, Lensfield Road. Lectures take place on Tuesday, Thursday and Saturday at 10:00 during the 8 weeks of full term (that is Tu.Th.Sa.10 in Cambridge shorthand). Cambridge teaching weeks start on Thursdays, so the first lecture will be on a Thursday. All lectures will also be available on Moodle.

Part IA Physics Lectures 2022/23		
lectures	**Course**	**Lecturer**
Michaelmas Term		
12	Dynamics	Prof. Jeremy Baumberg
12	Rotational Mechanics and Special Relativity	Prof. Ulrich Schneider
Lent Term		
12	Oscillating Systems	Prof. Neil Greenham
12	Waves and Quantum Waves	Prof. Mete Atature
Easter Term		
12	Gravitational and Electromagnetic Fields	Dr John Ellis

8.4 Practical Work

Laboratory work takes place at the Cavendish Laboratory (West Cambridge). The experimental laboratories are open on M.Tu.Th.F between 14:00-17:45. The laboratory may be approached by Madingley Road, or via the Coton cycle and footpath. For cyclists and pedestrians the latter is strongly recommended.

Students attend a physics practical for one afternoon once every two weeks. The primary aim of the class is the development of experimental skills, which are important to all scientists. A second

aim of the practical session is to illustrate ideas and concepts in physics. Some of the experiments are concerned with illustrating topics covered in the Part IA Physics lecture course, but this is not their main purpose.

Registration and assignment of days for practicals are dealt with centrally. You are expected to do your practical on the same day of the week in each term. The practicals are continuously assessed. In addition, to prepare for each practical you are asked to carry out a brief exercise beforehand which you will hand in to your demonstrator at the start of the practical class. To give you practice in technical writing you are required to do two formal reports. The first, partial, report, to be written over the Christmas vacation, will be based on one of the experiments carried out over the Michaelmas term. The second, to be written over the Easter vacation, will be a full report on one of the Lent-term experiments. Full details are given in your practical class manual, and tips and further advice is given in the booklet entitled Keeping Laboratory Notes and Writing Formal Reports, which is handed out to students at the start of the year. The overall practical mark counts 25% towards the Part IA Physics examination.

8.5 The Examination

The Part IA Physics written examination consists of one three-hour paper. The exact content of the paper is a matter for the relevant examiners, but the expected pattern will consist of short and long questions on the material covered in the lecture courses.

8.6 Books

There is a huge range of modern and excellent text books that cover our courses in Physics, and you are strongly encouraged to make textbooks a regular part of your learning habits. Lecture handouts are often excellent and complete, but are not designed to replace a well-written textbook.

There are two books specifically recommended for the Part IA Physics course – these will be available in College libraries. Some lecturers will give references both to relevant sections of these books, and to worked examples in them, which help explain or expand on the material they present in their lectures. This is to encourage you to develop your skills in utilising the more extensive resource material provided in text-books to deepen your understanding of physics.

- Understanding Physics (Second Edition), Mansfield M & O'Sullivan C (Wiley 2011).
- Physics for Scientists and Engineers (Extended Version), Tipler P A & Mosca G (6th Edition, Freeman 2008).

8.7 Important Dates

Please note that this list is not exhaustive, and may be superseded by announcements on the TIS or by email.

Part IA Physics: Important Dates		
Tue 4th Oct, 2022		Start of Michaelmas **full term**
Wed 5th Oct, 2022	10:45	Introductory talk
Thu 6th Oct, 2022		Start of Week 1: lectures begin
Fri 2nd Dec, 2022		End of Michaelmas full term
Tue 17th Jan, 2023		Start of Lent full term
Wed 18th Jan, 2023	16:00	Formal report deadline
Fri 17th Mar, 2023		End of Lent full term
Tue 25th Apr, 2023		Start of Easter full term
Wed 26th Apr, 2023	16:00	Formal report deadline
Fri 16th Jun, 2023		End of Easter full term

9 Part IB Physics A

9.1 Introduction and Course Aims

The objective of the IB Physics A course is to provide a self-contained package of courses in quantum physics, condensed matter physics, and waves and optics. The course builds on IA Physics and offers a firm grounding in important areas of physics that are very useful for scientists with a wide range of career destinations. It can be taken by those not taking Physics B; in this case IB Physics A might, for able students, lead to Half Subject Physics in Part II Physical Sciences but does not by itself lead to Part II Physics (for which both Physics A and B are required).

While it is also possible to take IB Physics B without IB Physics A, for the majority of students wishing to take a single physics option in Part IB, Physics A is likely to be the more attractive option.

9.2 Introductory Talk and Practical Allocations

Students will receive their practical allocation at the end of this talk.

Students taking the common combination of Physics A, Physics B and Part IB Mathematics should attend an **introductory talk on the first Wednesday of Michaelmas full term (5th October 2022) at 13:30.**

Students taking **a single IB Physics course (A or B)** also need to attend this introductory talk.

9.3 Course Content

The lecture course Oscillations, Waves and Optics covers central aspects of physical phenomena that underpin much of physics. The Quantum Physics course builds on this and treats quantum phenomena both from the Schrödinger equation and by means of operator methods. Condensed Matter Physics shows how ideas from waves and quantum mechanics can be applied to understand the properties of solids.

9.4 Mathematical Requirements

Physics A and Physics B both require mathematics beyond that in the syllabus for Part IA Mathematics for Natural Sciences; students not taking the Part IB NST Mathematics course should attend the lectures on Mathematical Methods given at the same time on weekdays during Michaelmas Term. This course is supervised, and covers all the additional mathematics required for both Part IB Physics courses, and for the Part II Physics core and options courses. It does not provide full coverage of the mathematics assumed for the Part II Theoretical Physics (TP) courses, but mathematically-able students would need to do some extra work during the long vacation after Part IB in order to catch up.

9.5 The Lecture Courses

Part IB Physics A Lecture Courses 2022/23			
lectures	Course	Lecturer	A / B
Michaelmas Term			
8	Experimental Methods	Prof. Pietro Cicuta	A
16	Oscillations, Waves and Optics	Dr Tijmen Euser	A
16	Mathematical Methods*(For those NOT taking NST IB Mathematics)	Dr Dave Green	A & B
Lent Term			
24	Quantum Physics	Prof. Claudio Castelnovo	A
Easter Term			
10	Condensed Matter Physics	Dr Andrew Jardine	A

*

9.6 Practical Work in Part IB Physics

Students studying either Physics A or Physics B, or both, are required to undertake laboratory work, which is continuously assessed. The Practical Classes (for both Physics A and Physics B) take place at the Cavendish Laboratory (West Cambridge). The IB experimental laboratories are open M. 1400-1745, Tu. 1000-1745, Th. 1000-1745 and F. 10:00-17:45. Students will attend either the Tuesday, Wednesday or the combined Monday&Friday slots. These will be allocated at the induction session at the start of term.

The details of the experiments to be completed and the assessment methods are contained in the Laboratory Manual available from the TIS.

9.7 The Examination

The IB Physics A examination consists of two three-hour papers. The practicals are continuously assessed and overall count approximately 25% towards the IB Physics A examination.Full details are given in the class manual and additional help is given in the booklet Keeping Laboratory Notes and Writing Formal Reports.

9.8 Important Dates

Please note that this list is not exhaustive, and may be superseded by announcements on the TIS or by email.

Part IB Physics: Important Dates		
Tue 4th Oct, 2022		Start of Michaelmas full term.
Wed 5th Oct, 2022	13:30	ALL IB PHYSICS - Introductory talk at the Cavendish Laboratory
Fri 2nd Dec, 2022		End of Michaelmas full term
Fri 9th Dec, 2022	16:00	Scientific report deadline if chosen for submission (see synopsis of Physics A practical class for details)
Tue 17th Jan, 2023		Start of Lent full term
Wed 22nd Feb, 2023 - Wed 1st Mar, 2023		Presentation of results of the Extended Investigation during normal Laboratory hours (students taking Physics A and B)
Fri 17th Mar, 2023		End of Lent full term
Mon 20th Mar, 2023	16:00	Scientific report deadline if chosen for submission (see laboratory manual for details)
Tue 25th Apr, 2023		Start of Easter full term
Fri 16th Jun, 2023		End of Easter full term

10 Part IB Physics B

10.1 Introduction and Course Aims

The IB Physics B covers a range of topics that are complementary to the IB Physics A course. **Students wishing to proceed to Part II Physics must take both Physics A and Physics B**.

Students taking both courses combine them with one other IB subject. While NST IB Mathematics is frequently taken, and is important for those wishing to pursue Theoretical Physics options within the Part II Physics course, students should be advised that this is both a demanding and constraining choice. (For students taking subjects other than Mathematics, appropriate support is provided through the Michaelmas Term course in Mathematical Methods.) The selection of a different subject in place of NST IB Mathematics provides greater breadth and gives greater choice of Part II/III subjects within the Natural Sciences Tripos, should Part IB physics not prove to be rewarding.

It is possible to take IB Physics B without IB Physics A, but this is not adequate preparation for Part II Physics. The practical work draws heavily on material from Physics A in the Michaelmas Term, and students taking just Physics B are advised to attend at least the Experimental Methods lectures from Physics A for necessary background. For the majority of students wishing to take a single physics option in Part IB, Physics A is likely to be the more attractive option.

10.2 Introductory Talk and Practical Allocations

Students will be allocated their practicals at the end of this talk.

Students taking the common combination of Physics A, Physics B and Part IB Mathematics should attend an **introductory talk on the first Wednesday of Michaelmas full term (5th October 2022) at 13:30.**

Students taking **a single IB Physics course (A or B)** also need to attend this introductory talk.

10.3 Course Content

The lectures on Electromagnetism cover key concepts in this important subject. Classical Dynamics provides more advanced approaches to classical problems than were given in Part IA, and introduces key concepts in fluid mechanics. Thermodynamics provides an introduction to classical thermodynamics and kinetic theory. The Computing course provides an introduction to scientific programming techniques and their application in physics-based problems.

10.4 Mathematical Requirements

Please read section 9.4 for details of the mathematical requirements of Physics B.

10.5 The Lecture Courses

Part IB Physics B Lecture Courses 2022/23			
Lectures	Course	Lecturer	
Michaelmas Term			
20	Electromagnetism	Dr Oleg Brandt	B
4	Classical Dynamics	Prof. Mike Payne	B
16	Mathematical Methods (for those NOT taking NST IB Mathematics)	Dr Dave Green	A & B
Lent Term			
2	Introduction to Computing	Prof. Hrvoje Jasak	B
16	Classical Dynamics	Prof. Mike Payne	B
8	Thermodynamics	Dr John Ellis	B
Easter Term			
8	Thermodynamics	Dr John Ellis	B

10.6 Practical Work

The practical work associated with this course is described in section 9.6 .

10.7 The Examination

The IB Physics B examination consists of two three-hour papers. The practical elements of this course (i.e. the practicals and computing) are continuously assessed and overall count approximately 25% towards the IB Physics B marks (out of this, 16.7% is from the computing mark, so computing counts for 4.2% overall). Students should note that roughly 16.7% of the marks for the practicals will come from a Head of Class Report (for those not doing Physics A) or from a Group Presentation of an extended investigation (for those doing both Physics A and Physics B). Full details are in the class manual and additional help is given in the booklet Keeping Laboratory Notes and Writing Formal Reports.

10.8 Important Dates

Please refer to section 9.8 for the list of important dates.

11 Part II Physics

11.1 Requirements

Students wishing to be admitted to read Part II Physics are required to have successfully completed **both the Part IB Physics A and Part IB Physics B courses**, or equivalent courses in the Mathematics Tripos.

11.2 The Three and Four Year Courses in Physics

There are two paths to graduating in Physics, both leading to a wide range of career options. Both groups of students take the same course in the third year. The paths are:

- 3-year course leading to B.A. honours degree: this path is designed for students with a deep interest in the subject but who do not intend to become professional physicists. It is a challenging course and exposes students to core areas of physics at an advanced level. Students on this path will graduate at the end of the Part II course with a B.A. Hons.
- 4-year course leading to an M.Sci. honours degree (master of Natural Sciences), together with a B.A. honours degree: students who wish to pursue a professional career in physics (for example in academic or industrial research) take the same third year Part II but **do not graduate at the end of the third year**. They must apply in the Lent term to read Part III Physics in the following year. Subject to requisite funding, college approval and achievement of a 2:1 result or better in Part II Physics, students are admitted to take Part III Physics in their fourth year. Both B.A. and M.Sci. degrees are conferred at the end of this fourth year.

The Part II Physics course is rather flexible, and can range from strongly experimental to highly theoretical physics, with a range of specialist options. There are possibilities for substantial independent work and for experience of industrial research.

There is no limit on the number of students taking Part II Physics and in recent years we have had about 140-150 students taking the course.

11.3 Induction

The course will begin with a meeting on the first Tuesday of Full Term, **4th October 2022, at 10:00.** at the Cavendish Laboratory, which all students should attend.

11.4 Outline Of The Course

The elements of the course are contained in the table in section 11.6.

Students taking Part II Physics must take all four Core courses in the Michaelmas Term, three or more of the Options courses in the Lent and Easter Terms, and Computational Physics. They must in addition take three or more courses from Physics Education, Theoretical Options and Other Further Work.

Students taking Half Subject Physics as part of Part II Physical Sciences will take any two of the Core courses in the Michaelmas term and any one of the Options courses in the Lent and Easter terms. Candidates also take two units of further work selected from Theoretical Options, Physics Education and Experiments. A prior knowledge of Physics equivalent to the material covered in Part IB Physics A and Part IB Physics B will be assumed.

Part II Physics contains work of two types: Core lectures in the Michaelmas term and Options lectures in the Lent/Easter terms, which are examined at the end of the year in via written exams, and units of ‘Further Work’, which are assessed during the year.

We do not expect any student to take more than the minimum number of units of work in any category. The great majority of students will find the workload demanding even at this level. We recognise, however, that some students may have good reasons for wishing to take additional courses for credit. Marks for all examination papers taken will appear on the student’s University transcript.

Within any part of the examination (options courses, Further Work) the best results meeting the minimum requirement will count towards the class for the year.

The aim of the Michaelmas Term lecture courses is to complete basic instruction in physics. In this term, there are four core courses:

- Advanced Quantum Physics;
- Relativity;
- Optics and Electrodynamics;
- Thermal and Statistical Physics.

In the Lent and Easter terms, four option courses are offered, introducing broad areas of physics:

- Astrophysical Fluids;
- Particle and Nuclear Physics;
- Quantum Condensed Matter;
- Soft Condensed Matter.

All students are also required to take the course on Computational Physics, which is assessed by a series of short exercises. In addition, an extended Computational Physics project is available as one of the optional units of Further Work.

The remainder of the Further Work offers a free choice. Students may select an experimentally-biased course by carrying out up to two experimental investigations (E1 and E2), each lasting two weeks. Alternatively, there are two possible courses in Theoretical Physics (TP1 and TP2), consisting of lectures plus examples classes, which run respectively in the Michaelmas and Lent terms. We expect that almost all students will offer at least one of E1 and TP1. Offering both TP1 and E1 is possible, but students should be aware that it does make for a challenging workload in Michaelmas term. Further optional elements of Further Work are a Computing Project, Research Review or Physics Education. The Theoretical Options are assessed by written tests (under exam conditions) of the material of TP1 and TP2 at the start of the term following the respective lecture.

There are also two non-examined courses offered in Part II. The “Concepts in Physics” course should appeal to all students taking Physics, giving a broad insight into the deep ideas and connections in Physics and you are **strongly recommended** to attend these lectures. “The Physics of Astrophysics” will appeal to those with an interest in physics applied on the largest scales, and who may be contemplating research in astrophysics in particular.

The full Part II course involves 10.2 units of credit: 7 of these are from examined courses, 3 from the main units of Further Work (FW), and 0.2 from the Computing Exercises. See the table for details. So, to a good approximation, each unit counts for one tenth of the total mark for the course (strictly 9.80%).

11.5 Further Work

Of the optional Further Work, note that not more than two Experiments may be offered. Other rules for choosing Further Work are set out in the table.

Students will be contacted by e-mail and should register on-line using the TIS before the start of Michaelmas Term and give an indication of which units of Further Work they intend to complete. In particular, they will be asked to make a provisional choice of experiments for E1 and E2 if they intend to take those options. These arrangements may be modified at the registration meeting at the beginning of term. Students wishing to change their choice during the course of the year (for example those wishing to take E2 instead of TP2 in light of their TP1 results) should contact the Undergraduate Office.

The arrangements for submitting and assessing Further Work are described below and in the online Course Synopses.

11.5.1 Computing

All students are expected to attend the Computational Physics lectures in Lent term, which build on the Part IB computational physics course. Associated with the lectures are Computing exercises which are equivalent to 0.2 units of work, and are compulsory for all Part II Physics students. In

addition, students may elect to offer an extended Computing Project, which will involve analysing a physics problem, and writing a program to solve it. This project is optional, and counts as one unit of Further Work.

11.5.2 Experimental Investigations

Each experiment will involve 30 to 40 hours work and will be equivalent to one unit of Further Work. The E1 and E2 sessions are run in the Michaelmas and Lent terms respectively, with individual experiments starting on the first, third and fifth Mondays in Term. The details of these sessions will be announced during registration at the start of term. E1 is assessed during the Michaelmas Term so that any appropriate advice and constructive criticism can be given before a decision has to be taken on whether or not to offer E2. Students opting for E2 only after taking the TP1 examination are likely to be allocated to E2b or E2c. No student is allowed to offer more than two units of experimental investigation or to take two experiments in one term.

The experiments available in Part II will give you the chance to develop professional ability, both in performing a substantial experiment and in relating experiment to theory. Most students find these experiments more demanding and more satisfying than the short experiments of the Part I classes. They are assessed by a Head of Class write up followed by an oral examination.

11.5.3 Courses in Theoretical Physics

The Theoretical Physics Courses are challenging courses aimed at students who are confident and able mathematicians, and who have a strong interest in the mathematical description of physical systems. The majority of students taking these courses will have taken Part IB Mathematics for NST, but the Mathematical Methods course offered as part of Physics A and B in Part IB provides nearly all of the necessary background. Usually the mark distributions for these courses have a tail of low marks obtained by students who would probably have scored higher marks if they had done experimental work.

Theoretical Physics Course TP1 is taken in the Michaelmas Term and students take a written test paper at the start of the Lent Term. The results will be made available to guide your choice of further work for the Lent term. A second Theoretical Course, TP2, is taken in the Lent Term and tested at the start of the Easter Term. TP1 and TP2 each count for one unit of Further Work. As well as lectures, four examples classes are given in each of TP1 and TP2.

11.6 Course Summary

Part II Physics Summary 2022/23					
#	Course	Lecturer/Head of Class	FW	Half-subject	Physics
Michaelmas Term – Core courses					
18	Thermal and Statistical Physics	Prof. Eugene Terentjev			✓
24	Relativity	Dr Anastasia Fialkov		choose	✓
24	Advanced Quantum Physics	Dr Paula Alvarez-Cartelle		2	✓
16	Optics and Electrodynamics	Prof. Paul Alexander			✓
Lent/Easter Terms – Option Courses					
8	Computational Physics	Prof. Austen Lamacraft	0.2	✓	✓
24	Astrophysical Fluid Dynamics	Prof. Chris Reynolds			
22	Particle and Nuclear Physics	Dr Tina Potter		choose	choose
22	Quantum Condensed Matter	Prof. Chris Ford		1	3 or 4
22	Soft Condensed Matter	Prof. Ulrich Keyser and Prof. Tuomas Knowles			
Further Work (FW), (1 unit ≈ 1.5hrs examination)					
	Research Review	Dr Dave Green	1	✓(*)	
	Physics Education (limited numbers)	Dr Michael Sutherland	1		
	Computational project	Prof. Austen Lamacraft	1	choose	choose
	Experiment E1	Prof. Pietro Cicuta	1	2	3
	Experiment E2	Prof. Pietro Cicuta	1		or more
	Theory: TP1	Prof. Ben Gripaios	1		
	Theory: TP2	Prof. Robert-Jan Slager	1		
Non-examinable Courses					
8	Concepts in Physics	Prof. Malcolm Longair		✓	✓
24	Topics in Astrophysics	Prof. Mark Wyatt		✓	✓
			FW units	2	3+
			Exam units	3	7+

* Half Subject Physics students must choose a Research Review as the topic for their dissertation in Part II Physical Sciences; this is an extended version of the standard Research Review, see section 11.10.

11.6.1 Research Review

A Research Review is equivalent to one unit of Further Work, and consists of a review (of 3000 words max.) on some area of physics, approved in advance. Such a review must have a Supervisor. In about the sixth week of the Lent Term supervisors will organise a meeting at which students will have the chance to present their interim work to other students working on reviews in similar areas and their supervisors. As well as providing a chance to obtain feedback this should ultimately raise the standard of the submitted work. You receive 5% of the available marks for the Research Review for giving the presentation (irrespective of its quality). Research Reviews are assessed by two staff members. The assessment includes a short oral examination early in the Easter Term. This examination will usually begin with a short oral presentation.

11.6.2 Physics Education

The Physics Education course counts as one unit of further work. It offers the possibility of developing and presenting teaching material in a secondary school. It develops a wide range of transferable skills and provides a real opportunity to explore the possibility of a career in teaching. Details of the nature and scope of this course are given in the course synopsis on the TiS. Numbers are restricted and students wishing to take part must attend the introductory session.

11.7 Supervisions and Examples Classes

Supervisions for Part II remain the responsibility of the Colleges and are organised by the Department on their behalf. During the Michaelmas term Physics students are supervised in all four core lecture courses, and Half-subject Physics students in two. Supervisions for these courses will be allocated automatically according to the option for which you are registered on the TiS.

In the Lent term students are supervised in their chosen optional courses, again according to their choices on the TiS. Please enter your choices before the last Friday of Michaelmas Full Term, so that arrangements can be made during the Christmas vacation. Obviously this does not allow you to sample the courses: if you subsequently decide that you wish to change options, then please visit or email the Undergraduate Office to request a change.

There will be 4 one-hour supervisions in each of the courses taken. Thus a student reading Part II Physics will receive 28 supervisions (7 courses), and those taking half subject physics will receive 12 supervisions (3 courses).

Supervision size depends also on supervisors availability but will normally be in groups of three. You are expected to work much more independently than at Part I. Difficulties that arise in lectures are often more conveniently discussed with the lecturers themselves, either at the end of lectures or by contacting them vie email or Teams.

You must take responsibility for ensuring that the supervisions go as far as possible in meeting your needs. Supervisors are usually willing within reasonable limits to be flexible about the detailed arrangements. You should expect to be asked to hand in work for each supervision, in time for your supervisor to look through the work and identify any potential problems. However, the quantity and complexity of the work at this level means that supervisors may be unable to provide the detailed personal marking that you experienced in Parts IA and IB

Supervisors may range from established lecturers with long teaching experience to relatively inexperienced graduate students. New supervisors are expected to seek advice on supervising, to attend the courses provided by the University, and to commit to the necessary preparation for each supervision. However, experience is the only real teacher, and inevitably some supervisors will be more confident than others, particularly at answering subtle and unexpected questions.

Without an influx of new supervisors the system will rapidly decay, so please be understanding. If you do have problems with your supervisor that cannot be solved by direct two-way discussion, please contact your Director of Studies in the first instance. If your DoS feels that intervention is warranted, they should contact the Undergraduate Office.

11.8 Non-Examined Work

There is a non-examinable course of 8 lectures in the Lent term on **Concepts in Physics**, intended to place in perspective some major themes of physics, to sketch connections between them and to investigate unresolved questions. Attendance is **strongly encouraged** for all students.

There is also a non-examinable course of 24 lectures in the Lent term on the "Physics of Astrophysics" given by staff of the Institute of Astronomy. These lectures should be of interest to all students, and are intended to provide valuable background for those who are interested in pursuing Astrophysical courses in Part III

Undergraduates are encouraged to attend the Cavendish Physical Society lectures, at 16:00 on some Wednesdays. Part II students are also welcome at the many Research Seminars and other lectures in the Department, including those organised by the Cambridge Physics Centre. These are advertised on notice boards, and on the Cavendish groups' web pages.

11.9 The Examination

11.9.1 The Written Papers for Part II

Each of the core and optional lecture courses is examined in a separate two hour paper.

11.9.2 Requirements

The written examinations consist of the core lecture course papers, plus three or four of the option lecture course papers. In addition to the computing exercises, three or more other units of Further Work must be offered and may be drawn from the various choices described in the table.

11.9.3 Examination Entries

You are required to make a preliminary indication of which papers you intend to offer when you fill in your exam entry on CamSIS at the start of Michaelmas term. You will then be required to specify which final combination of papers you intend to offer by modifying the exam entry during Lent term, in liaison with your College Tutorial Office. Any questions on completing the exam entry should be discussed with your Director of Studies.

11.9.4 Submission of Further Work

When any piece of Further Work is submitted it must be in a complete and final form.

Students are expected to meet the published deadlines for coursework. The departmental policy on late submission of coursework is stated in section 6.

Students are permitted to submit more than the minimum number of units of Further Work. Once a piece of Further Work has been submitted, it will be marked: the best marks for the required minimum number of units will count towards the class, but **all marks will appear in the markbook**.

TP1 and TP2 are assessed by written tests during the year, and are counted as units of Further Work. These tests are taken under normal exam conditions, but do not formally constitute Tripos Examinations. Once you have entered the room for the TP1 or TP2 test, that unit of Further Work will be included in the final marksheets and calculations.

The University Regulations require that assessed Records of Further Work be submitted to the Examiners via the Head of the Department; this happens automatically after assessment.

11.10 Half-subject Physics

Half-subject Physics is part of Natural Sciences Part II Physical Sciences. It comprises about half of the work load of Part II Physics, and may be combined with a subject from Part IB not previously taken.

Candidates offer

1. Two of the core lecture course papers.
2. One of the option lecture course papers.
3. Computing exercises and two units of Further Work (not including a Research Review).

In addition, Physical Sciences students must offer a dissertation on a topic consistent with their Half Subject. For Half Subject Physics this dissertation will be chosen on a topic from those offered for Research Reviews, but with a word limit of 5000 (rather than 3000 for a Research Review).

You will be required to specify on CamSIS which combination of papers you intend to offer. The final deadline will be communicated via your college, it typically lies in the third week of the Lent Term.

The arrangements for submitting Further Work are the same as those for Part II Physics candidates (see section 11.9.4).

11.11 Important Dates

This list is not exhaustive, and may be superseded by announcements on the TIS or by email.

Part II: Some Important Dates		
Wed 5th Oct, 2022		Start of Michaelmas full term
Tue 4th Oct, 2022	09:30	Introductory talk
Mon 10th Oct, 2022		Briefing for E1a, in relevant laboratory
Wed 12th Oct, 2022	14:00	First TP1 lecture
Fri 14th Oct, 2022	14:00	First TP1 examples class
Thu 20th Oct, 2022		Research review online form opens
Fri 21st Oct, 2022	17:00	E1a laboratories close
Mon 24th Oct, 2022		Briefing for E1b, in the relevant laboratory
Mon 31st Oct, 2022	16:00	E1a report submission deadline
Fri 4th Nov, 2022	17:00	E1b laboratories close
Fri 4th Nov, 2022	23:59	Final Research Review selection deadline
Mon 7th Nov, 2022		Briefing for E1c, in the relevant laboratory
Mon 14th Nov, 2022	16:00	E1b report submission deadline
Fri 18th Nov, 2022	17:00	E1c laboratories close
Mon 28th Nov, 2022	16:00	E1c report submission deadline
Fri 2nd Dec, 2022		End of Michaelmas full term
Tue 17th Jan, 2023		Start of Lent full term
Fri 20th Jan, 2023		TP1 written test
Mon 23rd Jan, 2023	12:00	First TP2 lecture
Mon 23rd Jan, 2023		Briefing for E2a, in relevant laboratory
Tue 31st Jan, 2023	14:00	First TP2 examples class
Fri 3rd Feb, 2023	17:00	E2a laboratories close
Mon 6th Feb, 2023		Briefing for E2b, in the relevant laboratory
Mon 13th Feb, 2023	16:00	E2a report submission deadline
Fri 17th Feb, 2023	17:00	E2b laboratories close
Mon 20th Feb, 2023		Briefing for E2c, in the relevant laboratory
Mon 27th Feb, 2023	16:00	E2b report submission deadline
Thu 23rd Feb, 2023 - Wed 1st Mar, 2023		Presentations of Research Reviews (will be organised by your supervisor)
Fri 3rd Mar, 2023	17:00	E2c laboratories close
Mon 13th Mar, 2023	16:00	E2c report submission deadline
Fri 17th Mar, 2023		End of Lent full term
Tue 25th Apr, 2023		Start of Easter full term
Wed 26th Apr, 2023	10:30-12:30	TP2 written test
Mon 1st May, 2023	16:00	Computing Report submission deadline
Mon 1st May, 2023	16:00	Research Review submission deadline
Mon 1st May, 2023	16:00	Physics Education submission deadline
Tue 2nd May, 2023 - Fri 12th May, 2023		Oral examination (viva) on Research Reviews (will be organised by your supervisor)
Fri 16th Jun, 2023		End of Easter full term

12 Part III Physics and the MASt in Physics

12.1 Introduction

The four-year course, of which Part III is the final component, is designed for students who wish to pursue a professional career in physics, in academic or industrial research. It leads to an honours degree of Master of Natural Sciences, M.Sci., together with a B.A., though the latter can in this case not be conferred until the end of the fourth year.

Part III Physics is a demanding course, and courses assume an upper second class level of understanding of the core and relevant optional material in Part II Physics. **Students wishing to progress into Part III physics must achieve at least a 2:1 in Part II Physics, or have received a dispensation from this condition from the Faculty Board.** The requirements for admission to Part III Physics for those who have not taken Part II Physics are published in the Reporter.

You must have made financial provision by securing a four-year grant from your LEA or equivalent funding body during your second year. If you have any doubt about this, you should see your college Tutor or Director of Studies without delay.

12.2 Master of Advanced Studies (MASt) in Physics

This is a taught postgraduate course, which consists of the same content as Part III Physics. The course is designed for students who hold a 3-year undergraduate degree and wish to pursue a taught Master's degree. The minimum entry requirement for the MASt is a qualification comparable to an upper second class or better Bachelor's degree in Physics. In addition, entry into the MASt in Physics is rather competitive and successful candidates typically hold or expect a first class Bachelor's degree or equivalent when applying.

12.3 Induction

Students will be e-mailed to register online before the start of Michaelmas Term. The course will begin with a meeting on the first Tuesday of Full Term **(4th October 2022) at 12:30** in the Pippard Lecture Theatre at the Cavendish Laboratory.

12.4 Outline of the Course

The course aims to bring you close to the boundaries of current research, and is therefore somewhat linked to the expertise of the specific research groups within the Cavendish. You make a series of choices as the year proceeds which allow you, for instance, to begin to specialize towards particular broad areas of physics such as condensed matter physics, particle physics, astrophysics, quantum physics or biological physics. These choices can also span over the spectrum from strongly experimental to highly theoretical physics, and you can choose from a range of specialist options.

There are four assessed elements to the Part III course:

1. Research Project: one third of total marks
2. Major Topics: one third of total marks
3. Minor Topics: one sixth of total marks
4. General Paper: one sixth of total marks

All students undertake a substantial research project, which counts for one third of the total marks for the course. The Michaelmas Term lectures are the Major Topics, which cover substantial areas of physics. You are examined in three or more of them at the start of the Lent Term. The Lent Term lectures are the Minor Topics, which cover more specialised areas, mostly of active research interest in Cambridge. You are examined in three or more of them at the start of the Easter Term.

We do not expect any student to take more than the minimum number of units of work in any category. The great majority of students will find the workload demanding even at this level. We recognise, however, that students may have good reasons for wishing to take additional courses for credit. Marks for all examination papers entered will appear on the student's University transcript. Within any part of the examination (Major Topics, Minor Topics) the best results meeting the minimum requirement will count towards the class for the year. You are of course free to attend as many lecture courses as you wish, without necessarily offering them for examination.

Some of the Major and Minor Topics are given by staff from other Departments such as the Institute of Astronomy, the Department of Earth Sciences and the Department of Engineering. You can also take as Major or Minor Topics certain courses given in Part III of the Mathematical Tripos, but you should note that the style of the Part III Mathematical Tripos Options and Examination is different from that experienced in the Part III Physics Options, reflecting the difference in approaches of the two Departments.

There is an optional course called Innovation and Entrepreneurship for Physicists during the Lent Term for credit in the Tripos replacing a Minor Topic.

Ability in general physics is examined in the General Paper at the end of the Easter Term.

12.4.1 Project work

All students must undertake a project which is worth a third of the year's total available marks. A list of projects will be provided by the beginning of the Michaelmas Term. Many of these will be supervised by members of the Physics Department, but members of other Departments will also be involved. The projects can be experimental, theoretical, computational, observational, or some suitable combination of these. There will be scope for initiative and originality in carrying out a project, and it should form a valuable preparation for a research career.

Project work should begin in Michaelmas term as soon as projects are allocated. The work continues throughout the Lent and first part of Easter terms. A written project report (5000 words maximum) will be submitted and assessed in the Easter term.

Communication skills are essential if you are to have a successful career in science. Toward the end of Lent term a meeting will be arranged in which you will have the chance to give a fifteen minute oral presentation on your project to other students working in similar areas and their supervisors and research groups. This presentation counts for 5% of the available marks for the project (irrespective of the quality of your presentation). You should note that about one-third of the total marks for the project will be based on an assessment of the quality of your written report and your ability to explain and defend your work in the viva.

Bench work on experimental projects should be substantially complete by the end of the Lent Term. You must submit your project report by the third Monday of the Easter Term, and it will be assessed by two staff members after an oral examination.

12.4.2 Major Topics

The lecture courses given during the Michaelmas Term cover major areas, and in each, physics is presented as a connected discipline drawing upon the material of the first three years to take the topic close to the frontiers of current research. Candidates choose three or more Major Topics for examination. The courses are listed in the table in section 12.9, and are examined at the start of the Lent Term (i.e. in January) by separate 2-hour written papers.

Students who are especially strong in mathematics may wish to replace one of the Topics above with Quantum Field Theory (QFT) course, also of 24 lectures, taken from Part III of the Mathematics Tripos. Students taking this course or one of the other courses borrowed from the Mathematical Tripos sit the same examination as the Part III Mathematics students in June (3 hour paper). **These courses and examinations are entirely the responsibility of the Department of Applied Mathematics and Theoretical Physics (DAMTP), and their traditions in examinations differ somewhat from those in Physics. Students wishing to take one or several of these courses should discuss this choice carefully with their Director of Studies to ensure it will suit their skills and**

interests.

12.4.3 Minor Topics and Other Lent Term Courses

You must choose for examination three or more of the large number of Lent Term courses listed in the table in section 12.9. The choices include:

Minor Topics These courses are given by the Department of Physics. They are more specialised than the Major Topics and typically build upon the material presented in the Michaelmas Term. Some of them assume specific knowledge of particular Major Topics — the syllabuses make clear which. They are examined by 1.5 hour written papers at the start of Easter term (i.e. April).

IDPs There are three Interdisciplinary Papers (IDPs) which are examined in separate papers/coursework at the end of the Easter Term.

Courses from Part IIB Engineering These are examined with the Part IIB Engineers at the start of Easter Term.

Course from Part III Mathematics The Advanced Quantum Field Theory (AQFT), Quantum Computation (QC) and Topological Quantum Matter (TQC) courses are taught and examined by Mathematics and may be substituted for one of the Minor Topics. The advice given in section 12.4.2 regarding the QFT course applies also in these cases, and should be heeded by students considering this course. Note that these courses, even though some of them are 24 lectures long, only substitutes one Minor Topic.

12.4.4 Further Work: Innovation and Entrepreneurship for Physicists

The course is given in conjunction with the NanoDTC, and will be assessed by the completion of assignments as described in the synopsis. You may offer this course in substitution for a Minor Topic course.

12.4.5 General Physics Paper

The Part III course is designed to build upon the physics covered in the first three years and will take many subjects to the frontiers of current understanding. However, it is important to retain core physics at the same time. For the purposes of this examination, core physics means the physics taught in Part IA Physics, Part IB Physics A, Part IB Physics B, and the Michaelmas term core courses of Part II Physics. The 2003 – 2022 General Papers available on the TiS indicate the type of question that will be set. They will be designed to emphasise the straightforward application of core physics to reasonable problems.

12.5 Restrictions On Combination Of Courses

While every effort is made to arrange the timetable, it is inevitable that some combinations of courses will be ruled out by their schedule.

12.6 Supervisions

Supervisions in Part III will be diverse in style, in recognition of students' advanced independent learning abilities and the complexity and variety of the material in the courses. Lecturers are expected to provide some form of learning support, but the form it takes is up to the individual lecturer. It is likely to take the form either of examples classes, with or without demonstrators (depending on the number of students), or of large-group supervisions or seminars. The lecturer may choose to announce arrangements during the first lecture, or may announce them through the class email list.

The class email list depends on each student signing up for the particular course on the TIS. You will be reminded about the sign-up before the start of each of Michaelmas and Lent Terms. If you decide to change options during the Term, you should make the necessary change on the TIS, and also notify the relevant lecturers directly.

12.7 Non-Examined Work

Part III students are welcome at the large number of Research Seminars and other lectures in the Department, particularly those organised by the Cavendish Physical Society lectures at 16:00 on some Wednesdays. These are advertised on notice boards, on talks.cam.ac.uk, and are summarised on the Cavendish web page.

12.8 The Examination

The course is assessed by project work and examinations. Major Topics and the Project each contribute approximately one-third of the total marks. The Minor Topics and General Physics Paper each contribute approximately one-sixth of the total marks.

The marks for all courses will appear on the University transcript, with the best marks for the minimum requirement being used to establish the final class for the Examination.

12.8.1 Examination Entries

Examination entries are made through the CamSIS on-line system, and should be completed in consultation with your Director of Studies. The deadline is usually about the middle of November, but you will be able to modify your entry for the Minor Topics papers in Lent term. Your College or Director of Studies will notify you about the relevant deadlines.

12.8.2 The Written Papers for Part III

Major Topics These examinations are taken at the beginning of the Lent Term (in January), and are 2 hour papers.

Minor Topics These are taken at the beginning of the Easter Term (usually April), and last 1.5 hours each.

General Physics Paper This is taken towards the end of the Easter Term, usually early June, and lasts 3 hours.

QFT/AQFT/QC Those students who have substituted these Part III Mathematics courses for Major or Minor Topics will take the same examination as the Mathematics students, towards the end of the Easter Term (usually in June).

Interdisciplinary courses (IDP) Each of the interdisciplinary courses is treated as a Minor Topic. The interdisciplinary courses will all be examined in separate papers during the main Examinations Period at the end of Easter Term.

Nuclear Power Engineering Students taking these Topics will be examined with the Part IIB Engineers in one and a half-hour papers at the start of the Easter Term.

12.9 Course Summary

Please check the course website for latest developments, lecture timetable and location.

Part III/MASt Physics 2022-23		
#	Course	Lecturer
Michaelmas Term – Major Topics: choose at least 3		
24	Advanced Quantum Condensed Matter Physics	Prof. Crispin Barnes
24	Atomic and Optical Physics	Prof. Zoran Hadzibabic
24	Particle Physics	Dr Chris Lester
24	Physics of the Earth as a Planet	Dr David Al-Attar/Dr Jerome Neufeld/Dr John Rudge
24	Theories of Quantum Matter	Prof. Austen Lamacraft
24	Relativistic Astrophysics and Cosmology	Dr Will Handley
24	Biological Physics	Dr Diana Fusco
24	Quantum Field Theory*	Prof. N Dorey
24	Quantum Computation*§	Dr Sergii Strelchuk
Lent Term – Minor Topics and Other Courses: choose at least 3		
12	Exoplanets and Planetary Systems	Prof. Didier Queloz
16	Formation of Structure in the Universe	Dr Nicolas Laporte
12	Gauge Field Theory	Dr Alex Mitov
16	Medical Physics	Prof. Sarah Bohndiek/Dr Gemma Bale
12	Advanced Statistical Mechanics	Prof. Eugene Terentjev
16	Colloid Physics	Dr Erika Eiser
12	Quantum Simulation	Prof. Ulrich Schneider
12	Non-linear Optics and Quantum States of Light	Prof. Mete Atature Smith
12	Phase Transitions	Dr Anson Cheung
12	Quantum Information	Prof. Crispin Barnes
12	Superconductivity and Quantum Coherence	TBC
16	Atmospheric Chemistry and Global Change (IDP1)†	Run by Chemistry (Prof. Pyle et al)
16	Climate Change and the Carbon Cycle: An Earth History Perspective (IDP2)†	Run by Earth Sciences (Dr S Turchyn)
12	Materials, Electronics & Renewable Energy (IDP3)†	Run by Physics (Dr S Dutton & Dr A Rao)
24	Advanced Quantum Field Theory*	Dr M B Wingate
12	Nuclear Power Engineering‡	Dr Geoff Parks
Further Work (may substitute a Minor Topic)		
	Innovation and Entrepreneurship for Physicists	Dr Karishma Jain
Other requirements		
	Research Project	Dr Louise Hirst
	General Paper	

*From Part III Mathematics †Interdisciplinary Paper ‡From Part IIB Engineering
§Note that QIT, despite being in Michaelmas term, can only substitute a minor option.

Students must offer three or more courses from Major Topics, together with three or more courses from Minor Topics. Quantum Field Theory may be substituted for one Major Topic. Courses from Interdisciplinary Topics, Quantum Computation, Advanced Quantum Field Theory, Nuclear Power Engineering, may each be substituted for one Minor Topic.

The courses from the Major Topics and Minor Topics and Nuclear Power Engineering, are examined at the start of the term following that in which they are given. Quantum Field Theory, Quantum Computation and Advanced Quantum Field Theory and courses from the Interdisciplinary Topics will be examined in June. The Entrepreneurship course from Further Work is continually assessed.

All students are recommended to attend the Non-examinable courses.

12.10 Important Dates

This list is not exhaustive, and may be superseded by announcements on the TIS or by email.

Part III/MASt Physics: Some Important Dates		
Tue 4th Oct, 2022		Start of Michaelmas full term
Tue 4th Oct, 2022	12:30	General Registration and Project Fair.
Fri 14th Oct, 2022		Supervisors can allocate projects
Wed 26th Oct, 2022		Deadline for choosing a project (but don't leave it this late!)
Fri 4th Nov, 2022	16:00	Deadline for submission of Project Risk Assessments
Fri 2nd Dec, 2022	16:00	Deadline for submission of initial project progress report.
Fri 2nd Dec, 2022		End of Michaelmas Full Term
Tue 17th Jan, 2023		Start of Lent Full Term
Mon 16th Jan, 2023 - Thu 20th Jan, 2022		Major Topic Examinations
Thu 9th Feb, 2023	16:00	Deadline for submission of brief project progress form (outlining progress and confirming that you have adequate material to complete the project).
Mon 6th Mar, 2023 - Fri 17th Mar, 2023		Presentations of projects (will be organised by your supervisor; some supervisors prefer to do these early in Easter Term).
Fri 17th Mar, 2023		End of Lent Full Term
Tue 25th Apr, 2023		Start of Easter Full Term
Mon 24th Apr, 2023 - Fri 28th Apr, 2023		Minor Topic Examinations
Mon 15th May, 2023	16:00	Project Report submission deadline
Tue 16th May, 2023 - Fri 26th May, 2023		Oral examination (viva) on Projects
Fri 16th Jun, 2023		End of Easter Full Term

13 Guide for Students

Administration The Department's central administration is located in the Bragg Building. Enquiries are usually dealt with via Room 206.

Aims and Objectives The Quality Assurance Agency, through its institutional audit of the University, is concerned with the assurance of the quality of teaching and learning within the University. The University in turn requires every Department to have clear aims and objectives and to monitor their teaching and learning activities and consider changes where necessary, and meet various criteria concerning management of the quality of its teaching provision. Students play a vital role in assisting with this quality assurance, and the Department welcomes constructive comment via the Staff-student Consultative Committee.

Appeals Information about the procedure for examination warnings, allowances and appeals is available at http://www.admin.cam.ac.uk/students/studentregistry/exams/undergraduate/exams.html.

For information about instigating a review of an examination result see 'Examinations Review Procedure' below.

Astronomical Society (CUAS) Astronomy and astrophysics are popular branches of physics, and the Astronomical Society provides an interesting and accessible series of lectures held on Tuesday evenings during the Michaelmas and Lent Terms in the Wolfson Lecture theatre, Chemistry department, as well as the opportunity to observe using the historic refractors owned by the Institute of Astronomy. Details can be found on the society's web page http://www.cam.ac.uk/societies/cuas. Members of the research groups of the Cavendish Laboratory concerned with astronomy and astrophysics are often lecturers in this series.

Battcock Centre for Experimental Astrophysics The Cavendish has a large and active astrophysics research group. Their research base is at the Battcock Centre, a new building located on the north side of Madingley Road opposite the Cavendish, and next to the Institute for Astronomy: Battcock Centre map.

Bicycles The Cavendish Laboratory provides several cycle sheds and racks in which you may leave your bike, but it should be locked with a sturdy security device when not in use. Several serious accidents occur every year involving students cycling in Cambridge: please cycle with care, use proper lights when required and wear a safety helmet.

Books Reading and working through relevant books are indispensable exercises. All books recommended for Part I should be available in College libraries or the Rayleigh Library. If you notice any omissions, please fill in a request slip to ensure that the book is ordered.

Bookshops Cambridge is well equipped with bookshops. There is a discount available at the CUP bookshop with a University Card.

Buildings The present Cavendish Laboratory comprises the extensive buildings south of Madingley Road, the first of which opened in 1973. A map of the Cavendish Laboratory site is shown on the inside back cover. The original buildings on this site were the Rutherford, Bragg and Mott Buildings, named after former Cavendish Professors, and the workshop building between the Rutherford and Bragg buildings. These have in the past few years been supplemented by a building for the Interdisciplinary Research Centre (IRC) in Superconductivity (now the Kapitza Building), and a further building for the Microelectronics Research Group and Hitachi Cambridge Laboratory. Further recent additions to the site are the Magnetic Resonance Research Centre of the Chemical Engineering Department, the Physics of Medicine (POM) building, which houses the laboratories for the Biological and Soft Systems sector (BSS), the Nanoscience Centre and the Terrapin Building. The most recent additions are the Battcock Centre for Astrophysics, which houses the Astrophysics Group and is located on the north side of Madingley Road close to the Institute of Astronomy, and the Maxwell centre next to the POM building.

Calculators When considering which calculator to buy, you may wish to bear in mind that only certain types are permitted for use in Tripos examinations. Among these are the Casio models available from the Cavendish Stores. Calculators will also need the 'official' Board of Examination yellow sticker which can be obtained from the Undergraduate Office at the Cavendish.

CamCORS The supervision reporting system. See Databases (below)

CamSIS The student information system. See Databases (below)

Canteen See 'Common Room' and 'West Hub' (below).

Careers The University Careers Service is located in Stuart House, Mill Lane (telephone number 338288), and is financed by the University to provide students with information about careers and assistance with application processes. The Service maintains an information room which can be used during normal office hours, and additionally provides expert staff to advise students about career-related issues. Ask at the reception desk.

Cavendish Laboratory The Cavendish Laboratory is the name of the building which houses (most of) the University's Department of Physics; the name has become synonymous with the department itself. The laboratory was established through the generosity of William Cavendish, Seventh Duke of Devonshire, who endowed the laboratory in the nineteenth century, together with the Cavendish Chair of Experimental Physics. The original Cavendish Laboratory building is located in Free School Lane in the centre of the city, and opened in 1874. The Department moved to the current buildings on the West Cambridge in 1973-74. The history of the Cavendish is well illustrated in the Cavendish Museum, located in the Bragg Building.

The two newest physics buildings in West Cambridge are the Physics of Medicine building ("PoM"), and the Maxwell Centre, which have a physical connection. The Maxwell Centre houses some Cavendish research groups and brings together industry and forefront research work in various areas: see Maxwell Centre for more details.

The University map shows the current site, but is not always completely up to date with new buildings: University Map of the Cavendish

Cavendish Stores Next to the Common Room in the Bragg Building is the central stores of the whole laboratory, the opening hours of which are 08:00-16:45. The stores sell approved calculators for examinations.

Cheating The Department and the University consider any act of cheating as a serious matter, and any incident will be reported to the Head of Department, who will normally refer the case to the University Proctors. It is unacceptable to:

- cheat during oral or written tests;
- copy the work of others and submit as your own;
- falsify and/or invent experimental data.

In the practical classes, some experiments are designed to be carried out individually and some in collaboration with other students. Discussion among students and with demonstrators and Heads of Class is encouraged and you may use any help or insights gained in these discussions to improve your experiment, your understanding of the physics and your written report. However, your report should be written by you, following the guidelines on writing reports, and only data collected in your experiment should be presented as your own.

The Department has access to the latest anti-plagiarism software tools and will use them from time to time to monitor coursework submissions for plagiarism, and so ensure fairness for all students.

Classing Criteria The Department of Physics has a policy that examiners will mark to agreed criteria for written examinations. Due to the way in which marks from different subjects are combined to create the final list in Parts IA and IB, the criteria used in Physics are not reflected directly in the

class list. For Parts II and III, the examinations are under the direct control of the Department, in conjunction with scrutiny by External Examiners. The criteria for classing in Physics are available at http://www.phy.cam.ac.uk/students/teaching/current-courses/classing

College Your College ordinarily admits you to the University, provides you with accommodation and arranges for your supervisions in Parts IA and IB. Usually, but not always, your Director of Studies in Physics will be a member of staff of the Cavendish, and will be directly in touch with the Department. Most Colleges aim to provide supervision at a rate of about one hour per week for each of Part IA Physics, Part IB Physics A and Part IB Physics B. Part II and Part III supervision is provided on behalf of the Colleges through a scheme administered in the Department.

Common Room The Cavendish contains a large Common Room which is open to all students of Physics. It does not serve food but contains seating space and a microwave if you wish to bring your own lunch. There is no provision of hot food in the department, but see 'West Hub'. In addition there is an area for relaxation outside the lecture theatres, where there are vending machines for food and drink.

Complaints We very much hope you enjoy your course, receive a great education and have positive interactions with the department's staff. However, if you are unhappy with the experience you have received from the department, or a member of staff, the University has a well-defined *Student Complaint Procedure* for you to use. The Department takes such issues extremely seriously, and details of process to follow can be found on the website of OSCCA, the Office of Student Conduct, Complaints, and Appeals: OSCCA website.

Note that, if your complaint concerns *a college*, you should normally follow that college's complaint own procedure.

The OSCCA process has three-stages. It begins, in Step 1, with an attempt at *local resolution* of the issue, that is, within the Department. You should raise your complaint either directly with the relevant staff member (if you feel able to do so), or else via one of the *Responsible Officers* in the department; this should *normally be done within 28 days* of the event triggering the complaint. The Responsible Officers in the Department for undergraduate student complaints are the Director of Undergraduate Education, and the Departmental Administrator. If you need advice on whether or how to make or proceed with a complaint, you could also ask your College Tutor or Director of Studies, or your CUSU representative, or any member of the physics teaching staff.

If the local resolution fails to deal satisfactorily with the complaint, Step 2 requires a *formal complaint* to be made and investigated, and the details for this can be found on the OSCCA website.

The full statement of the University process can be found here: OSCCA's Student Complaint Procedure.. There is also available a Quick Guide to the process.

If you have experienced Harassment or Sexual Misconduct, there is a separate University support and reporting process; please see the section on Harassment and Sexual Misconduct.

Computing The Department relies on the University Information Services http://www.uis.cam.ac.uk/ for provision of computing facilities for undergraduates. The `eduroam` wifi service is available throughout the laboratory. There are some PCs with access to printers in the library. Most colleges also provide some facilities. The Department makes increasing use of computers in practical work, and aims to develop specific skills in the use of computers for solving problems in physics.

Copyright While you are a registered student, you will have access in printed and electronic form to a large range of learning materials prepared by the department. These are usually the intellectual property of the lecturer who created them, and/or the University as a whole. Copyright

law is somewhat complex, but allows lecturers some limited 'fair use' of existing copyright materials when used for students on specific courses. However, **you are not legally allowed to distribute these handouts further by electronic or other means**. If you have any doubts about this, please contact the department.

Counselling The University Counselling Service http://www.counselling.cam.ac.uk/ exists to help members of the University who have problems of a personal or emotional nature which they wish to discuss in confidence. The Service is widely used, so it can be busy. In times of particular stress a special effort will be made to see you quickly.

Advice on personal matters is always available in your college through your Tutor.

Special assistance is provided by Linkline (internal telephone 44444) and the Samaritans (telephone 364455).

Databases Students taking courses in Physics will come across a number of different on-line databases. Because these all use the same login method ("Raven" authentication: see below), it is not always obvious that these are different systems, which for the most part do not (yet) talk to each other. The main databases are:

- CamCORS – the Cambridge Colleges Online Reporting System. Supervisors use this to report to Directors of Studies and Tutors on the progress of their supervisees, and to claim from the colleges for the supervisions provided. If colleges choose to release the information, students can view their supervision reports here directly. See http://www.camcors.cam.ac.uk/
- CamSIS – the student information system. Students use this university-wide system to enter for exams, and (when the results are uploaded) to check their Tripos results. subject choice through this system. See http://www.camsis.cam.ac.uk/
- The Teaching Information System (TIS) – a web database system run by the Department of Physics. All course resources are provided here and the system is used to e.g. assign Part II and III students to supervisors, to assign part II research revoiews and part III projects, and to submit your research review or project reports. It is therefore important that all students are registered with the TIS in addition to entering for examinations on CamSIS. (see Registration: below). See http://www-teach.phy.cam.ac.uk
- The University's timetable tool (http://timetable.cam.ac.uk) allows you to create your own timetable of lectures and practicals, and add to your own electronic calendar.
- Moodle: Moodle is the virtual learning environment for the University (https://www.vle.cam.ac.uk). It is used for instance to provide access to lecture capture videos. While heavily used in IA courses, physics courses in later years then to rely mostly on the TIS, as it permits better integration with other Departmental systems.

Department of Physics The Department of Physics is the administrative unit in the Faculty of Physics and Chemistry which provides teaching in physics leading to the Part II and Part III examinations in Physics. The Head of Department is Professor Andy Parker. Your direct contact with the Department can be through your College (your Director of Studies in the first instance) or through the staff you encounter in lectures and practicals. The needs of students in Part I are usually met fully through College contacts; in later years direct contact with the Department increases. The Department provides various facilities specifically to help you in your study of physics, many of which are described in this document.

Director of Studies You will have been assigned a Director of Studies in your College - possibly one for Physics and another for Natural Sciences overall. This person will assign you to supervisors during your first two years, will monitor your progress and try to assist you if you have problems. If you get into difficulties with the course you should discuss this with your Director of Studies, or with your Tutor. If for any reason you feel unable to do this any member of staff of the Department will willingly try to assist you.

Disability The Department works closely with the University's Disability Resource Centre (DRC) to ensure that the needs of students with disabilities are accommodated. Students with disabilities should seek support from their College and the DRC, and the DRC will then inform the Department regarding the any special arrangements that need to be made. It is also helpful to inform the Undergraduate Office in good time to allow arrangements to be made; you can also disclose relevant information on the TIS, so that your teachers will be made aware.

Email Email is the key communication channel between students and the department. Please ensure you read and monitor your University inbox regularly.

Examinations The marks upon which your degree classification is based are derived from a combination of continuously-assessed work, set pieces (such as projects and research reviews) and written examination papers.

You may find these two links which describe the classing criteria used helpful. For part IA and IB, the NST guide is at http://www.cam.ac.uk/about/natscitripos/exams/. For Parts II and III, the departmental criteria are described at http://www.phy.cam.ac.uk/students/teaching/current-courses/classing.

The Physics Department has produced some guidance on exam preparation which you might find helpful and is available on the teaching pages on the web at http://www.phy.cam.ac.uk/students/teaching/exam_skills. If you have problems it is worth discussing them with your supervisor, Director of Studies or your Tutor, who may be able to assist by suggesting alternative approaches.

Information on the various styles of questions is available at http://www.phy.cam.ac.uk/students/teaching/exam_questions, and you will find a brief description of how examiners work at http://www.phy.cam.ac.uk/students/teaching/exam_workings. Internal examiners are appointed each year for each Tripos examination; two external examiners are also appointed for Parts II and III. The names of examining committee members are available in the Reporter and on the Physics teaching webpages. For each subject there is a Senior Examiner drawn from the staff of the Department, and they take the responsibility for the setting and marking of the examination papers, assisted by the other examiners. You may also find interesting the reports on exams made by the Senior and External Examiners which are available on the TIS.

You should note that, by tradition – in order to ensure that the examination process is beyond reproach – direct contact with the examiners is not encouraged. If you have a problem that you believe should be brought before a particular body of examiners, the proper channel is through your Tutor or Director of Studies.

There are useful University guides to the Tripos Examinations system. This webpage Policy & Guides is run by the Student Registry and contains several useful links.

And this guide is focused on student perspectives on examinations.

In addition, this guide written in 2017 may be of interest: University Examination Guide

Selective Preparation for Examinations There has been some discussion with past students about the advisability of 'ditching a course' in preparation for the examinations. The Department gave the following advice:

- Departmental policy is that the examinations should test the whole course taken by students. The examinations are designed to test the wide range of skills and knowledge that has been acquired.
- In any section of an examination paper, there is likely to be a range of questions which you will find to have differing degrees of difficulty and also testing different aspects of each course.
- It is very dangerous indeed to 'ditch courses'. It results in a very limited range of questions which can be answered - how do you know they are not all going to be very demanding?

It requires enormous effort to be sure that you can answer well any question which can be set on any given course. It is much safer, and educationally much sounder, to prepare for all the courses for which you are entered in the Tripos examinations. You are much more likely to find two questions out of four in which you can perform well.

Note that also exam formats are constantly evolving and in recent years choice has been removed from e.g. the Part IA and IB exams. This means that is even more important than previously to prepare the whole course.

Examinations Review Procedure The University's has a detailed review procedure for examinations, and this can be accessed at: http://www.studentcomplaints.admin.cam.ac.uk/examination-revie

Examples Classes In several lecture courses from the third year onwards, Examples Classes are provided as an important aid to your learning. They explore in greater depth some particular issues related to parts of the lecture course, and with a number of demonstrators on hand they should be used to strengthen your grasp of the course material.

Examples Sheets Examples sheets are provided to accompany every lecture course, and are usually distributed outside the lecture theatre and via the TIS. It is the policy of the Department to provide examples which cover a wide range of difficulty, so don't expect to be able to do all of them without some assistance from your supervisor. You should try to produce satisfactory solutions to all of the designated 'core' examples for your subsequent use in revision, after discussion of the material in a supervision. Many of the questions are taken from past Tripos papers, so they provide good practice in handling material in the lecture courses, chosen to reflect the present content of the course.

Faculty of Physics and Chemistry The Department of Physics is part of the Faculty of Physics and Chemistry.

Feedback The Department makes a great effort to provide excellent courses and facilities. We greatly appreciate feedback from students which helps us improve our courses. Your input is most helpfully directed through your representative on the Staff-Student Consultative Committee (see below). You will be emailed links to feedback questionnaires. Please fill these in with constructive comments – these responses are the key input to the Consultative Committee, and the information is then passed on to the lecturers, Heads of Class and supervisors.

You can also send suggestions or comments to the Director of Undergraduate Education or the teaching office (undergraduate-office@phy.cam.ac.uk).

Students often believe their comments are not taken seriously or acted upon. This is absolutely not the case! Lecturers and other staff read feedback carefully and attempt, where possible and sensible, to respond. Almost every course we give has been positively improved by constructive student feedback. It really makes a difference.

Fire Alarms All buildings are equipped with fire alarms, and you should take note of the instructions, which are posted around the buildings, for the procedure to follow in case of fire. There is a fire drill at some time each year. If you hear a fire alarm leave the building quickly and quietly by the nearest fire exit. Do not stop to collect your possessions. Do not use lifts. Fire doors in corridors close automatically when the alarm system is activated; they must never be obstructed. The system is tested between 07:30 and 08:30 each Monday.

If you discover a fire, raise the alarm by breaking the glass at the nearest Fire Alarm Point, and evacuate the building by the nearest safe route. If it is possible to do so without taking personal risks call the Fire Brigade (telephone 1999 from a University network telephone).

Formulae A booklet of standard mathematical formulae, identical to the one that is made available in certain examinations, is available for purchase from staff in the Undergraduate Labs, or for downloading from here. You are urged to use and become familiar with the contents of this booklet, because it has become clear in recent Tripos examinations that many students are not aware of the time it can save them in an examination.

Handbook This Physics Course Handbook is updated each year and is the defintive source of information about the courses. It is to be found online at http://www.phy.cam.ac.uk/students/teaching. The individual course synopses are available on the TIS. Students may be informed by email of corrections and updates. Please send any comments on errors or omissions by e-mail to undergraduate-office@phy.cam.ac.uk.

Harassment and Sexual Misconduct The University is committed to creating and maintaining an environment for work and learning which is free from all forms of discrimination. The Department and the central authorities of the University regard racial, sexual and disability harassment and bullying as wholly unacceptable behaviour. Information about harassment is available at http://www.studentcomplaints.admin.cam.ac.uk/harassment-sexual-misconduct, and includes links to webforms for anonymous reporting of harassment and sexual misconduct. For other complaints, please refer to the complaints section of this guide.

Institute of Physics The Institute of Physics is a national body that exists to promote physics. Following graduation you may obtain (according to experience) various grades of professional membership, Chartered Physicist status, and several other benefits which may have some bearing on obtaining a job.

Late Submission of Work The departmental policy on submission of course work after published deadlines is described in section 6.

Lecture handouts Handouts, containing material to supplement lectures, are usually distributed at the time of the relevant lecture outside the lecture theatre and on the TIS. The amount of material prepared is at the discretion of the lecturer. Diverse opinions have been (vociferously) expressed by students each year about handouts - some want very little material, others wish to have copies of lecture overheads, others want a substitute for a book. When lecture overheads are supplied there are often criticisms that the lecturer is reading from the handout! It is impossible for the Department to provide courses and handouts which satisfy every different preference. Lecture handouts should be regarded as assistance beyond the lecture material, optionally provided by the lecturer, but they cannot substitute for your own reading through the wide range of textbooks available throughout the University, and you cannot reasonably expect them to. Lecture handouts are available from the TIS.

Lectures Most Part IA lectures are usually held in the Bristol-Myers Squibb Lecture Theatre, The Chemical Laboratory.

The Part IB Physics A and Physics B lectures will be held in the Cockcroft Lecture Theatre on the New Museums Site during Michaelmas and Lent terms. During Easter term these move to the Zoology and Physiology Lecture Theatres.

Part II and Part III lectures are usually held in the lecture theatres and seminar rooms at the Cavendish Laboratory, or in the Sackler Lecture Theatre at the Institute of Astronomy.

Libraries Library provision in Cambridge is outstanding. Your College will probably provide a core of physics books to supplement those you buy. Usually the College Librarian will welcome suggestions for additional purchases if you find omissions of important books from the College Library.

The Department provides the Rayleigh Library, located on the first floor of the Bragg building. An area is set aside for use by Part II and Part III students, and there is an extensive collection of textbooks on all aspects of physics. These, and books from the main section of the Library, may be borrowed overnight after completing the borrowing procedure at the desk next to the main door to the Library . There are several MCS computers available as well as printing facilities.

The University Library has an extensive physics collection.

Physics journals are held in the Rayleigh Library and in the Moore Library in Wilberforce Road (see below). Online access to many physics journals is available within the cam domain.

MASt This is a taught postgraduate course, which consists of the same content and assessment as Part III Physics. The course is designed for students who hold a 3-year undergraduate degree who wish to pursue a research degree. The entry requirement for the MASt is a qualification comparable to an upper second class or better UK Bachelor's degree in Physics. In recent years we have had a MASt class of 10-20 students who join us from degree programmes in the UK and worldwide. The intention is that they become fully integrated with the Part III class.

Moore Library The University's main collection of physical sciences, technology and mathematics journals is kept in the Moore Library in the Centre for Mathematical Sciences in Wilberforce Road (close to the Cavendish, just turn left at the end of the footpath leading from the Cavendish into town, instead of continuing down Adams Road; the large building on the right near the far end of the road is the CMS). To use the collection you need to have a University Card. It is unlikely to be useful to you until the Third and Fourth years.

Natural Sciences Tripos The Natural Sciences Tripos (NST) is the official title of the degree examinations covering the Natural Sciences, including Physics. The participating Departments of the University work together to provide a wide choice of subjects which can be combined in a great variety of ways to cater for the interests of each student.

Many students seem unclear about how the Part II and Part III examinations are Classed. The following is an extract from notes prepared in order to clarify the Department's position on this:

Part III of the Tripos is classed in the usual way - 1st, 2.I, 2.II, 3rd. Parts II and III of the Tripos are independent and marks are not carried forward from one to the other.

Degrees as such were traditionally not classed. However, this is changing - please see the NST website for more information. Students graduate from the University as a B.A. 'with Honours' and, if they are classed in Part III, as an M.Sci. The classes are attached to a particular Tripos. Thus if, for example, a student obtains a First in Part II, they will be entitled to say that they obtained 'First Class Honours in Part II of the NST' whatever their results in Part III. If they also obtain a good result in Part III then they can add that to their curriculum vitae. If future employers, postgraduate grant funding agencies, etc. require more detailed information than just the degree certificate, they will normally receive from a College or the University the full profile of the student's achievements during their years here, not just their result in the final year. This should enable them to give proper weight to the Part II results.

It is worth noting that many of the key decisions about job offers and places in research groups will be made before the Part III results are known, so the Part II classes are likely to be an important factor in those choices. The Research Councils normally require a specific standard to be met if students are to be eligible for postgraduate support. At present a student is eligible for a Research Council grant if at least an Upper Second has been attained in either Part II or Part III. It is unlikely that a poor result in Part III would lead to an offer of a place from any university, even if the formal requirement had been attained at Part II.

See also Classing Criteria, above.

Past Tripos papers Recent papers are available on the web at http://www-teach.phy.cam.ac.uk/dms/dmsSearch.php?type=examPapers. Remember that the course content changes, so past papers may contain questions on material with which you are not now expected to be familiar!

Philosophical Society The Philosophical Society is a long-established society in the University which, among its various functions, puts on evening lectures in the Bristol-Myers Squibb Lecture Theatre, Department of Chemistry. Some of these are by eminent physicists and all are intended for a broad audience - you are therefore most welcome to attend. More details are available at http://www.cambridgephilosophicalsociety.org/

Photocopying and Printing May be carried out in the copy room of the Rayleigh Library for a small charge.

Physics Society (CUPS) The Physics Society organises a range of functions, including evening lectures. Joining is easy at the first evening lecture or at the Societies' Fair. More details are available at http://physics.soc.srcf.net/.

Plagiarism See Cheating (above).

Practical Laboratory Work Your work in the Teaching Laboratoratories is an important part of your course and will help you develop the experimental skills and knowledge which are important to all physicists. These sessions are run in the Cavendish Laboratory and are continuously assessed. Registration procedures are outlined in the relevant section of this handbook. The manager of the Teaching Laboratories is Richard King rjk45@cam.ac.uk

Rayleigh Library The Rayleigh Library is primarily a resource for research, but it includes a great many useful reference works as well as original research journals. Here you can also find New Scientist, Scientific American, Physics World (for those who don't have their own copy!) and Physics Today. All of these are excellent sources of information about the fast-advancing frontiers of physics. Next to the section with these and other current journals is the Part II & III Library. There is limited space for private working.

Raven Raven is the University of Cambridge web authentication server, see here for more information. You will need your Raven password to log in to the Teaching Information System (q.v.), and to access "cam-only" material (such as past examination papers) on the teaching website from outside the cam.ac.uk domain. If your login is rejected by the teaching system, please let the Undergraduate Office know your CRSID so that we can enable your account.

Ray Dolby Centre The Ray Dolby Centre, a completely new laboratory for research and teaching, is currently being built on the paddock site in front of the vet school, opposite the Computer Laboratory, on J J Thomson Avenue. Construction is planned to be completed in 2023.

Recording of Lectures Most lectures will be recorded using the University's Lecture Capture system called Panopto and will be available shortly after the lecture on the Moodle page of the course. They will remain accessible until the end of the academic year.

Audio or video recording of lectures by the students is not allowed, unless special permission has been granted. If recording is required to accommodate a disability, then the Disability Resource Centre should be approached. If there are other specific reasons for needing to record a lecture then a request should be made to the Undergraduate Office, who will consult the relevant lecturer.

Registration There are two main IT systems (see Databases) important for the organisation of your studies. The Department runs the Teaching Information System (TIS), an extensive set of teaching databases, and uses these, for example, to contact all students in any particular category.

Note that the TIS does NOT enter you for examinations, or have any official function outside the Physics Department, but it does get you into the system so that we know you are here, and what you are doing. We are then able to allocate departmental supervisions where appropriate, and to give you access to all relevant information.

Reporter The University Reporter is the official publication of the University in which announcements are made. The paper version of the Reporter is no longer be produced. For all official notices concerning examination procedures see http://www.admin.cam.ac.uk/reporter/.

Research The Cavendish is a large and thriving research laboratory, with a wide range of present-day interests in physics. Check the Cavendish website for details of the various research areas currently active in the department.

Safety Safe conduct is legally the individual responsibility of everyone in the workplace, whether they be student or staff member. Additionally the Department has specific legal obligations regarding health and safety, which are monitored by the Departmental Health and Safety Committee. You will be given information about health and safety in the Practical Laboratories in particular; please take in this information, and accord it the importance it deserves. Particular rules apply to Part III Project work; they are detailed in the section describing the arrangements for projects. The Departmental Safety Officer is Saba Alai (Room 220, Ext. 37397, sa792@.cam.ac.uk).

Central Science Library The University's main collection of scientific journals has been split into two. Journals related to the physical sciences, technology and mathematics are kept in the new Moore Library in the Centre for Mathematical Sciences in Wilberforce Road (close to the Cavendish, just turn left at the end of the footpath leading from the Cavendish into town, instead of continuing down Adams Road; the large building on the right near the far end of the road is the CMS). The other journals are kept in the SPL in Bene't Street, which was originally the Philosophical Society's Library and still houses the offices of the Society. To use the collection you need to have a University Library card. It is unlikely to be useful to you until the third and fourth years.

Smoking The entire Department of Physics has been designated a NO SMOKING AREA.

Staff-Student Consultative Committee (SSCC) The SSCC is the official channel for the communication of students' concerns to the Department. There are one or two student representatives for each of the courses provided by the Department. Elections to the SSCC take place early in the Michaelmas term during lectures. The Consultative Committee is chaired by Dr Melissa Uchida, and the other members are the Head of Department, the Director of Undergraduate Education, and further representatives of the Teaching Committee. The Committee meets in the middle and at the end of each term, just after lectures finish, and a major part of its business is to discuss in detail the feedback on each course, particularly as reflected by questionnaires. The Committee also provides feedback to the Teaching Committee on general teaching issues.

The Committee's minutes are considered in detail by the Teaching Committee and by the Head of Department, and are made available on the TiS (https://www-teach.phy.cam.ac.uk/teaching/sscc.php where the current membership may also be found).

Supervisions Supervisions are the responsibility of the colleges and are organised through your college for Parts IA and IB. Supervisions and examples classes for Part II and III are organised by the Department on behalf of the Colleges. You are normally expected to attend every supervision which you have arranged, as a courtesy to your supervisor as well as in order to benefit your own studies. You should expect to be asked to hand in work for each supervision, in sufficient time for your supervisor to look through the work and identify any potential problems.

If for some reason you have problems, please contact your Director of Studies in the first instance, even for supervisions arranged by the Department.

Synopses Moderately detailed synopses for every course offered by the Department can be found on the TiS; the synopses have been arrived at after long deliberation, consultation, and debate within the Department. The relationship between courses is handled by the Teaching Committee, and every effort is made to refine the sequence in which material is presented. Some problems remain; these should just be the ones for which no clear-cut solution was available, but in case there are difficulties for you which have not been identified in advance, the Staff-Student Consultative Committee always welcomes direct feedback via your representative.

Teaching Committee The committee concerns itself with all aspects of teaching and learning in the Department of Physics. It oversees the structure of lecture courses and practicals, and weighs up information about the success of the courses regularly during the academic year. The best route for communicating information to the committee is through your representative on the Staff-Student Consultative Committee, which itself reports to the Teaching Committee. The Teaching Committee is chaired by the Director of Undergraduate Education.

Teaching Information System (TIS) The TIS is a web interface to the various teaching databases maintained by the Department: it is available at http://www-teach.phy.cam.ac.uk/. Part IA students can view their practical marks on the web; Part II and III students can select Research Reviews and Projects here, and can view their further work marks in the same way if they have been released. All supervisions arranged by the department are listed, and you can use the system as an easy way to email your supervisors and supervision partners (for Parts II and III). All handouts, for all years, are available via the TIS.

Note that you must first be registered (see "Registration") for the current year in order to gain access to these facilities, and that many of them require you first to log in, using your Raven password (see under "Raven").

Telephones The internal telephone network of the university provides 'free' calls between extensions, most of which have a five-digit number.

To reach an extension from another exchange line outside the network, the number is prefixed with a 3. (Some recent lines have 5-digit number beginning with a 6, for which the prefix when dialling from outside is a 7).

Undergraduate Office The Undergraduate Office (sometimes referred to as the Teaching Office) is situated in the Bragg building, Room 179, tel. 65798. The office is run by Helen Marshall and is open for general enquiries at regular times during full term. Enquiries can also be made to its e-mail address: undergraduate-office@phy.cam.ac.uk.

University Library The University Library is an amazing resource for the University (and in many disciplines, for the international academic community). You may be surprised at how useful it can be for you. However, since it is so large it can be a little complicated.

Your University Card is required to gain access to the University Library.

You cannot take bags etc. into the library for security reasons, but you can leave them in the metal lockers to be found down a few steps on the right hand side of the entrance hallway. The keys are released by the insertion of a £1 coin, which is returned to you when you open the locker.

Most of the relevant physics books are to be found on the shelves in 'South Front, Floor 4' - easily located on the maps displayed throughout the building. You need to know that in order to maximise storage, books are shelved in catalogue sequence, but split into different size categories. This means that you might find four different sets of books on, say, atomic physics - the size is indicated by a letter a,b,c in the catalogue number. They are easy to find once you know this! Periodicals ('serials') have numbers prefixed with P.

An increasing proportion of the 7,500,000 items in the inventory of the library are appearing on the computer catalogue, which can be accessed from any computer terminal which can connect to the network. The catalogue will tell you where the book should be found (eg SF4 i.e. South Front Floor 4) and whether or not it is out on loan (and if so, when it is due back). The same catalogue system allows you to check your College library catalogue (for most of the colleges) and that of the Rayleigh Library. The UL catalogue is available at http://www.lib.cam.ac.uk/.

Website The Cavendish Laboratory's home page http://www.phy.cam.ac.uk/ has notices about events in the Cavendish, lists of staff and details of the activities of the various research groups, as well as teaching material and information. This Physics Course Handbook and teaching material for various courses can be found at http://www.phy.cam.ac.uk/students/teaching/. The Teaching web pages also provide links to the Teaching Information system and to certain material that is not generally available to addresses outside the cam.ac.uk domain.

West Cambridge This is the name of the campus on which the Cavendish buildings sit, extending from the current Cavendish buildings to the M11 motorway in the west. The whole of the

University's West Cambridge site is currently under active development, with many new buildings being constructed, and many more planned. It will become the principal physical sciences campus of the University.

West Hub The new West Hub on JJ Thomson Avenue is only two minutes away from the Department and contains a canteen, coffee shop, bar and shop as well as many study spaces. See www.westcambridgehub.uk/ for details.