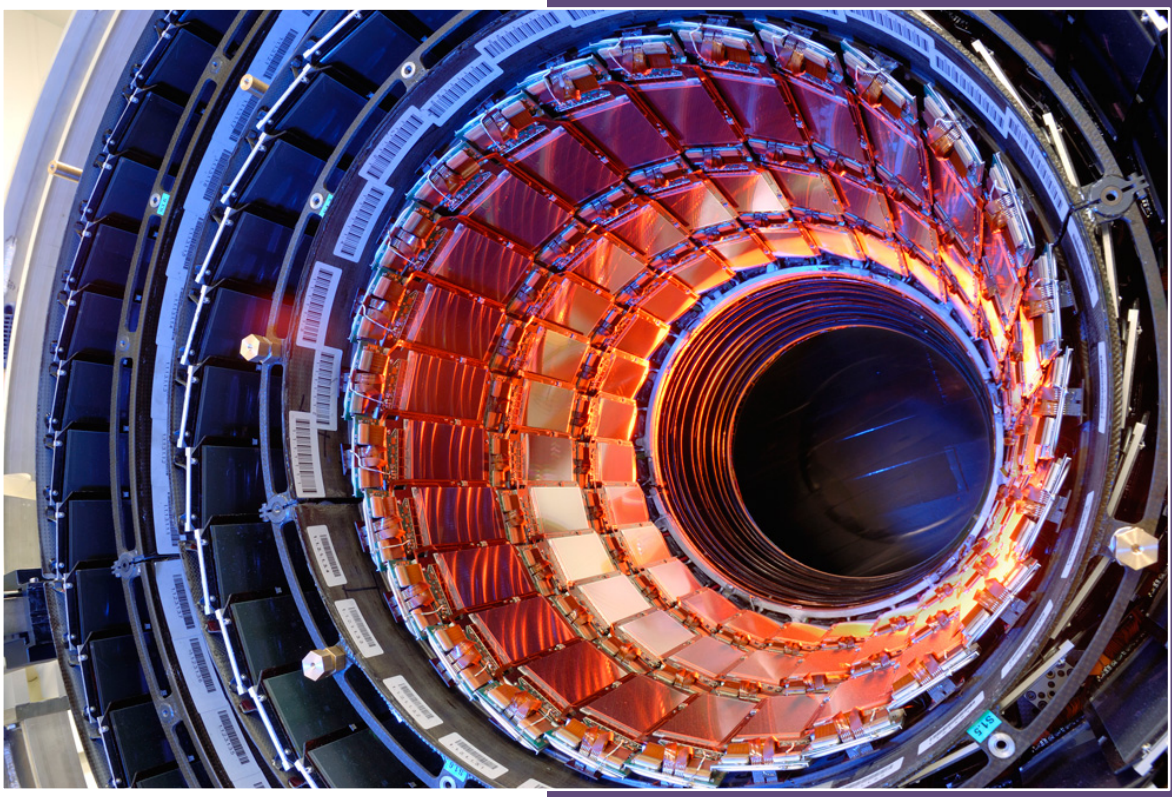
2018-2019

The Undergraduate Handbook



The School of Physics and Astronomy

http://www.physics.manchester.ac.uk

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University of Manchester

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Disclaimer: Please note that this handbook was correct at the time of printing. Changes and amendments may occur throughout the academic year and these will be reflected in the online version.

Please send any changes/updates to Suzanne Nightingale **suzanne.nightingale@manchester.ac.uk**

Details on ALL Course Unit Syllabuses can be found here

Who's who in the School of Physics and Astronomy?

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The External Examiners

ROLE	NAME	UNIVERSITY
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External Examiner (all MPhys/BSc degree programmes)	Prof. Veronica Sanz	University of Sussex
External Examiner (all MPhys/BSc degree)	Prof. Robert Taylor	University of Oxford

*Please note: that it is inappropriate for students to make direct contact with External Examiners under any circumstances, in particular with regards to a student's individual performance in assessments. Other appropriate mechanisms are available for students, including through the School's own procedures and committees, the University's appeals or complaints procedures and the UMSU Advice Centre. In cases where a student *does* contact an External Examiner directly, External Examiners have been requested not to respond to direct queries. Instead, External Examiners should report the matter to their School contact who will then contact the student to remind them of the other methods available for students. If students have any queries concerning this, they should contact the Teaching and Learning office.

The external examiners have asked to meet some students from all years, informally, to discuss the course in general. This will be arranged on the day of the finals examination meeting, in June 2019. The date will be available on Blackboard once confirmed. Any student still in Manchester then will be invited to meet them over lunch.

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For general school enquiries including; room bookings, unofficial transcript processing, programme changes and course unit selection physics@manchester.ac.uk

Email for Student Support and Welfare physics.support@manchester.ac.uk

The School Teaching and Learning Office is located on the First Floor of the Schuster Building and is open from 9.00 a.m. to 4.00 p.m. Monday – Friday. Here you will be able to access information and advice on all undergraduate teaching/support issues.

1. Introduction

This handbook provides information on the degree programmes taken by undergraduates in the School of Physics and Astronomy at the University of Manchester. All of the programmes organised by the School of Physics and Astronomy are subject to the Regulations, Ordinances and policies of the University of Manchester. Nothing stated in this handbook is meant to supersede or modify any of these except where specific exemptions have been granted by the Faculty of Science and Engineering.

1.1 The School Buildings

The School of Physics and Astronomy is housed across three buildings on south Campus, the Schuster building and Schuster Annexe, and the Alan Turing building. The Jodrell Bank Observatory in North Cheshire is about 30 km (20 miles) south of campus. The Schuster Annexe is a new building which opened to staff and students in November 2017. The brand new facilities include: the first year laboratory, PC clusters, quiet and communal study. The majority of members of staff have offices in the Schuster building which is also where most teaching of physics students takes place. Access to Schuster building is via the main entrance which is located on Brunswick Street, soon to be Brunswick Park. The Alan Turing building is comprised of three connected blocks. Staff in the Jodrell Bank Centre for Astrophysics (JBCA) have offices on the 3rd floor of the central and northern blocks of the Alan Turing building. Members of the Photon Science Institute (PSI) have offices in the PSI which is housed within the block of the Alan Turing building - closest to Schuster building.

The Teaching and Learning Office is located on the First Floor in the Schuster building along with all student-facing services (Student Experience Services). The ground floor of the Schuster building houses the Rutherford, Bragg, Blackett and Moseley lecture theatres. The teaching laboratories are located on floors 1 to 5 of North-South limb of Schuster building, whilst research laboratories are housed within the East-West limb. A large, purpose built mechanical workshop is housed within G26, which is located on the northern side of the Schuster building, adjacent to stores and the main goods bay.

1.2 Master's and Bachelor's Degrees

Undergraduate students may graduate with a Bachelor of Science degree (BSc) after three years of study or with a Master of Physics degree (MPhys) or Master of Mathematics and Physics (MMaths&Phys) after four years of study. The relation between the BSc and MPhys degree programmes is as follows:

- Both degree programmes prepare students for careers as professional physicists. Our high academic standards enable our BSc and MPhys graduates to compete effectively for postgraduate studentships.
- Both degree programmes prepare students for employment as scientifically aware graduates in industry and in commerce. In particular, both degree programmes develop the ability to communicate clearly and confidently, to analyse complex problems, to describe events using precise terms, to use modern technology confidently and to have an understanding of the principles underlying technology.
- The BSc is ideal for students wishing to obtain an excellent and highly valued undergraduate degree leading to a wide range of career paths. It also provides entry to specialised postgraduate masters degrees suitable for particular careers.
- The fourth year of the MPhys provides additional opportunities for students to show initiative, to learn independently, to research and to gather information. It requires students to undertake projects which provide insight into the nature of research in experimental or theoretical physics and to study topics in advanced physics in depth. To continue on the four-year programme a

student requires a mark of 55% in the second year assessment and a third year mark above 50%. Many MPhys students progress to postgraduate study.

Decisions on whether to graduate after three years with a Bachelor's Degree or after four years with a Master's degree are normally taken at the end of the second year of study. In special circumstances, students who opt for a Master's degree may request to be considered for a Bachelor of Science degree at the end of the third year, but before registration at the beginning of the fourth year, provided they have successfully completed the examinations in the first three years at The University of Manchester.

1.3 Degree Programmes Available

Physics	BSc (Hons) or MPhys (Hons)
Physics with Astrophysics	BSc (Hons) or MPhys (Hons)
Physics with Philosophy	BSc (Hons) or MPhys (Hons)
Physics with Study in Europe	MPhys (Hons) only
Physics with Theoretical Physics	BSc (Hons) or MPhys (Hons)
Mathematics and Physics	BSc (Hons) or MMath&Phys (Hons)

1.4 Academic Year

The academic year is divided into two semesters each consisting of 12 weeks of teaching followed by a revision and examination period.

Important Dates for the Academic year 2018-2019

University of Manchester Academic Year 2018-2019

SEMESTER	EVENT	START DATE	END DATE
ONE	Welcome Week 2018-2019 [Registration]	*17th September 2018*	*21st September 2018*
ONE	Teaching weeks 1-12	*24th September 2018*	*14th December 2018*
ONE	Timescale for registering options	*13th July 2018*	*5th October 2018*
ONE	Independent Study Week (YRs 1-3)	*29th October 2018*	*2na November 2018*
ONE	Vacation	*15th December 2018*	*13th January 2019*
ONE	Exam Period	*14th January 2019*	*25th January 2019*
TWO	Teaching weeks 1-10	*28th January 2019*	*5th April 2019*
TWO	Timescale for registering options	*13th July 2018*	*8th February 2019*
TWO	Vacation	*6th April 2019*	*28th April 2019*
TWO	Teaching weeks 11 & 12	*29h April 2019*	*10th May 2019*
TWO	Exam period	*15th May 2019*	*5th June 2019*
TWO	Borderline interviews with External Examiners	*20th June 2019*	*21st June 2019*
THREE	Re-Examination period	*19th August 2019*	*30th August 2019*

1.5 Email Communication with students

Communication with students is usually by email. In particular, most important communications from the University, e.g. exam registration, are sent by email. All official emails will be sent to your university email address. If you wish, you can set up your account to forward mail to your "personal" email account, but you should email staff from your university account.

Please ensure that you check your emails on a regular basis.

1.6 Student Services Centre

For advice on fees and loans etc. students should contact the Students Services Centre on Burlington Street. (Campus map 57)

Tel: 0161-275-5000

Email: ssc@manchester.ac.uk

1.7 University Life

Information on all aspects of university life from accommodation to sport, including sources of support outside the School, is available in the on-line **Crucial Guide**.

1.8 Health and Safety Induction

All new students will be required to complete satisfactorily four brief safety induction modules on **Blackboard**, before the first laboratory session.

1.9 Equality, Diversity and Inclusion

The School is committed to providing an environment where all students and staff are treated with dignity and respect. The life of our School is enriched by the diversity of its students and staff. The School has a dedicated Equality, Diversity & Inclusion (ED&I) committee that meets 3 times a year to consider all aspects of ED&I. Key staff in the school (e.g. Chief Examiner, Director of Teaching & Learning) are expected to provide an annual report to the School on EDI issues in their area, which are then actively discussed by the committee. UG student reps attend these meetings and provide the student voice in the process.

We are proud of our Institute of Physics Juno Champion and Athena SWAN Silver awards for gender equality. We consider all aspects of equality, diversity and inclusion, whether relating to the **protected characteristics** or any group that might feel they are being treated unfairly.

2. An introduction to studying Physics at Manchester

2.1 Academic Year

The academic year is split into two semesters. The first semester (S1) consists of registration week, twelve teaching weeks before Christmas, and two examination weeks in January. The second consists of twelve teaching weeks starting immediately after the S1 exams interrupted by a three week Easter vacation, and three examination weeks in May/June. Week 6 of semester 1 is designated "independent study week" for years 1-3; it is a useful break in routine to enable students to catch up and consolidate but it is not a vacation and students are expected to be in Manchester. In first year mid-semester tests are scheduled then, and other years may have other activities. Schools running external options may or may not observe that break.

2.2 Hours of Study

In every semester students undertake a variety of timetabled activities, mostly in the categories of lectures, laboratories, tutorials, workshops and examples classes. In first year these add up to about 20 hours per week. In order to benefit from these activities, however, it will be necessary to spend around another 15 to 20 hours per week in studying lecture notes, reading relevant sections of textbooks, tackling problems and reading round the broader subject. In later years the balance shifts gradually from timetabled activity towards private study. Studying for a degree in Physics is a full-time occupation, and any other activities undertaken, including paid employment, should not be more than can be fitted into your leisure time.

2.3 Credits

The material of each semester is divided into course units whose workload and contribution to assessment is measured in "credits", adding up to 60 credits per semester. Broadly speaking it is expected that 10 hours work will go into gaining each credit. (These match the system used in the vast majority of UK universities, and are equivalent to 1/2 of a standard European credit). University regulations specify that students have to successfully complete 120 credits per year in order to progress and graduate. Of the 100 hours expected for a 10 credit unit in first year, typically 30 hours are taken up by classes (lectures, tutorials, workshops, and laboratory sessions) and 70 hours by independent study including working on problem sheets or reports and revision.

In Physics each lecture course and each semester's laboratory in first and second year is worth 10 credits. Thus for most students in most semesters of the first three years, the 120 credits are made up of 5 lecture courses and lab in each semester. Minor variations are listed in the individual programme pages, and in fourth year the project takes up 20 credits per semester leaving 4 lecture courses to make up the remaining 40 credits in each semester.

2.4 Structure of course

A degree programme is not a collection of unrelated credit-rated course units. In the first three years most lecture courses are prescribed; these are the core subjects. Examples in first year are Quantum Physics and Relativity in semester 1 and Properties of Matter in semester 2. Students on the Physics programmes also have optional units to choose in each semester. While the majority of students choose from a range of courses provided by the School of Physics and Astronomy, options from other Schools and also UCIL (the University College of Interdisciplinary Learning) can also be chosen, ranging from mathematics to languages. Students on the other programmes will have less choice, as units to support their second subject are compulsory. However all students cover the basic core of physics, which allows easy transfer into the Physics programmes if students change their mind about their specialisation. It is also quite

common for students on the Physics programme to take, as options, courses which are compulsory for Physics with Theoretical Physics or Astrophysics, and even—if they do well—to switch into these programmes. This illustrates a general point that even in first year students should choose their options with an eye to what they want to do in later years, as some optional course units in each year are required or recommended for future optional course units.

2.5 Lectures

The primary method of communicating material to students in most course units is the lecture, and a 10-credit unit will typically have two 50-minute lectures per week. Attending lectures ensures that you are aware of the material you need to master week-by-week, and what will be covered in tutorials and workshops in the following week. However you should plan to spend at least as long reviewing the material with the aid of textbooks and other course materials as you spend in lectures, as well as working on examples. On-line materials for lecture courses are available via Blackboard (see below).

You are strongly encouraged to attend lectures in order to get the maximum benefit from your course of study. If you have to miss a lecture (through illness, for example), all lectures are available via pod casts (available under tools on your **My Manchester** home page). It is vital that you catch up within the week, though, as the lecturer will assume familiarity with the material in subsequent lectures and it is hard to recover if you allow yourself to fall behind.

2.6 Laboratory

In first year, laboratory sessions last for 6 hours, weekly. Students work with a partner and undertake a range of activities and (typically two-day) experiments, each of which is assessed at the end; there is no practical examination. The very first sessions are computer-based and develop the skills of processing and understanding data. In subsequent years the experiments are typically longer (four weeks in third year) and students have a choice of which experiments they undertake. The **first-year lab website** contains pre-lab information which should be accessed before starting each experiment. Laboratory work is assessed partly though formal reports and partly through interviews, informal in early years and more formal and including presentations in third year.

2.7 Tutorials, workshops and examples classes

In addition to lectures and laboratories, activities are scheduled that support students' learning in one or more subjects. In first and second year students are assigned to tutorial groups, typically of 5 students on the same programme. First year students have two academic tutors and meet with each weekly.[1] One of these tutors is also designated the student's personal tutor who will continue to provide advice and guidance throughout the student's studies. Tutorials consolidate the material provided in core lectures and provide opportunities to ask questions on these and on wider topics in Physics. **Weekly problems** are set, work on which is handed in to the tutors before the tutorial. The work is reviewed by the tutor in order to provide students with feedback on their progress and current understanding of the course. 5% of the assessment for each core unit is based on this work and on attendance at tutorials. The system is similar in second year but with a single tutorial per week with a new academic tutor.

In first year there are also large-group workshops to develop problem solving in the more mathematical aspects of the course. In third year there are large-group examples classes which cover core physics in both semesters and general physics in the second semester; again the aim is to deepen students' understanding

1 Except Mathematics and Physics, who have one tutorial in Physics and other classes in Maths see section **7.2 Mathematics and Physics [BSc, MMath&Phys]**

of core material and to develop their problem-solving skills. Some options courses also have examples classes associated with them. None of these contribute to assessment.

In first year the course "Dynamics" also has weekly online tests that contribute to the course marks. The tests can only be accessed via a code that comes with your own copy of the first year textbook Young and Freeman. All first year students will receive a free hard copy of the 'University Physics with modern Physics' book during Welcome Week.

Working together with fellow students to overcome problems and test your understanding is encouraged in tutorials, workshops and examples classes, though you should never directly copy another student's work.

2.8 PASS (Peer-assisted study scheme)

In first year, your tutorial group will be assigned two mentors from second or third year. They know just what it is like to be new to the University, and will be able to help you with all sorts of information and advice about living and studying here, and to manage the transition from A-level to undergraduate study. Even after you have settled in, they will provide weekly timetabled sessions which provide a safe environment where academic issues are discussed, and study skills and learning strategies are developed in order to increase academic confidence. Students in subsequent years can volunteer to act as mentors and find the experience very useful in consolidating the first-year material.

International students can also participate in the **International PASS scheme**. This consists of regular meetings with an International Student Support Leader and will run alongside the existing PASS scheme offered to all 1st year UG students. For further information please visit the **PASS website**. You will meet your allocated International Student Support Leader during Welcome Week. Afterwards, your International Student Support Leader will contact you to arrange your support meetings throughout the year.

2.9 Online

Students will be familiar with **My Manchester** before arrival; administrative matters, access to personal timetables, course unit selection etc. are dealt with here. The University's virtual learning environment is **Blackboard** where more Physics-specific material can be found; every course has its own page, but in addition there is a "**UG Virtual Common Room**" where a variety of useful materials may be found including timetables for all courses and past exam papers, and the **tutorial website**. Only the courses that you are currently registered for are visible to you directly on Blackboard. A **separate entry point to all course units** is also available in order, for example, for you to research options. The University library has many **ebooks** available.

Other resources available to support your learning are detailed in **Section 6. Learning Resources**

2.10 Other academic activities

Other activities throughout the period of a student's degree provide breadth and develop other skills. In the first year, students attend lectures on topics at the forefront of research in the School and, working in their tutorial groups, produce a booklet to make one of these topics accessible to A-level students. (The marks for this activity are included with a number of other elements in the laboratory mark.) In second year there is a core computing course. In the run-up to second and third year, students write an essay to develop the skill of writing about Physics in a less technical style. Second year students also undertake "professional development" activities designed to start the process of planning a career. BSc students write a dissertation in their final year, while MPhys students undertake one long or two shorter research projects, writing reports and giving presentations for assessment. At the end of the second and third year, students take an exam on general physics to ensure that the foundations of the subject are not forgotten as

the courses taken become more specialised. These activities do contribute to the year marks though some are outside the credit framework, see **Section 8. Course Units**

2.11 Examinations

While laboratory work is continuously assessed, lecture courses are almost all examined primarily by examinations at the end of each semester; that is mid to late January and mid-May to early June. Satisfactory performance in these exams is required to progress each year; if exams are missed or failed in first and second year they may need to be resat in August (called referred assessment). As mentioned above, tutorial work and attendance makes a small contribution to the mark for core courses; there are also mid-semester tests in the first semester of first year. The overall pass mark for modules is 40%, though progression on the masters programmes at the end of second and third year requires performance at a higher level. Marks from all years contribute to the final degree, though third and fourth year are more highly weighted (we do not operate a simple grade-point-average system). If you get less than 40% for a lecture course in 1st or 2nd year you may need to resit the exam in August. See **Section 12. Progression and Degree Classification Regulations** for full details.

Final degrees may be classified as Ordinary or with Honours. Honours degrees have classes ranging from Third to First, with the latter requiring a final average mark of 70% or more. First year assessments tend to be somewhat better done than subsequent ones, so students wanting a "good degree" should be aiming in first year for an average above 70%. Even though first year marks do not have a high weighting in the final degree classification, for the vast majority of students the first year sets their trajectory for the subsequent years. Good habits of study if established early will reap dividends later. Just as importantly, every lecture course starts by assuming a good mastery of previously met material. In first year, some students may get acceptable marks through last-minute cramming, but this does not build a foundation of solid knowledge for subsequent years.

2.12 Illness and other problems

Almost every student will encounter some problems in the course of their studies, from minor illnesses through relationship problems and family illness to serious on-going health problems. The University wants to support students in these circumstances, but this can only happen if student seek help in a timely fashion. Sections **4. Student Support Welfare and Guidance** and **11. Student ill-health and other matters affecting work and assessment** cover how to report absence, how to obtain support for short or long-term conditions interfering with study and assessment, and how to inform the examiners of unforeseen circumstances affecting examinations. Please read them carefully now, BEFORE you need them. You **MUST** also register with a local GP, and inform the Student Support and Welfare Officer in the School Teaching and Learning Office of pre-existing issues and disabilities if you have not already done so.

3. Attendance, Work and Conduct

3.1 Attendance

Studying at university is an activity undertaken by adults who take responsibility for ensuring that they study diligently, including attending all appropriate classes, in order to maximise the educational and learning benefit they derive from the course.

However, experience shows that students sometimes need more formal encouragement to attend and work in a satisfactory manner, and the University encapsulates this formally in **Regulation XX, the Monitoring Attendance and Wellbeing of Students** document. For the purposes of the regulation, in the

School of Physics and Astronomy, the "Programme Committee" is the school's Teaching and Learning Committee, which discharges its responsibilities under this regulation by delegation to the respective Year Tutors and Year Laboratory Tutors.

You should aim to attend all lectures, laboratory classes, workshops, tutorials and examples classes associated with your programme, and the core and optional course units which you have selected. Each Year Tutor may designate attendance at certain classes as compulsory, and attendance at these classes is recorded and monitored. Attendance data is also used to protect student wellbeing by helping to identify students who may need additional support. If you are unable to attend any such class because of poor health, you should complete a **Short Term Absence form**.

Attendance at weekly tutorials is compulsory in first and second year. It is monitored and recorded by your tutor, as is the effort you put in on the examples sheets for the core courses. To demonstrate satisfactory effort, you need to hand in work in advance of tutorials. 5% of your assessment on each core course unit is based on work and attendance at tutorials.

Attendance at all your scheduled laboratory classes is compulsory, and you are required to complete experiments and submit reports as specified by the Year Laboratory Tutor. In all years, failure to reach the pass mark overall in lab (40%) means that you may not graduate or progress to the next year. There are no lab resits, so a failure in lab constitutes the end of your studies in the school. In your final year, submission of a satisfactory dissertation (BSc) or the satisfactory completion of project work (MPhys) are required in order to be awarded an honours degree.

Attendance at all examinations is compulsory. Any student who misses an exam for any reason should contact the Teaching and Learning Office immediately to inform the School of their reason for absence. Any student who without good cause fails to attend all written papers in any examination period will be deemed to have withdrawn from the course.

Please note that if you are studying in the UK on a Tier 4 visa, you may be subject to additional attendance checks in order to comply with the terms of your visa.

3.2 Student Conduct

It is important that every member of the School, whether staff or student, is committed to creating an environment where everyone is treated with dignity and respect. The School and University encourages students to work together to ensure the School remains a pleasant and supportive place to work and study. This also extends to any student-focussed social-media platforms including Facebook and Twitter.

The School and the University has a zero-tolerance policy towards any form of harassment, discrimination, victimisation or bullying. Any allegations of these behaviours will be investigated and, if appropriate, disciplinary action will be taken. We will also not tolerate victimisation of a person for making such allegations in good faith or supporting someone else to make such a complaint.

This code of behaviour applies to the ways in which we all interact with each other, whether between students, between staff, or between staff and students.

Please take some time to read the following University policy and procedures in this area, including the definitions of what we consider to be bullying, harassment, discrimination or victimisation:

- **Students: Dignity at Study and Work Procedure**
- **Staff: Dignity at Study and Work Procedure**

For further information including ways to report and obtain support see the **We Get It** website

Students must also avoid academic malpractice such as plagiarism or collusion, for more details see **Section 10.2 Plagiarism**

4. Student Support Welfare and Guidance

A variety of sources of guidance are available to students. The most important of these are listed below. In the case of any personal problems, a student is encouraged in the first instance to contact the Student Support and Welfare Team in the Teaching and Learning Office. If you have an academic-related question, such as choice of courses, you should start by talking to your Personal Tutor. Then, if you need further information or permission, you may need to contact your Programme Director or Year Tutor. If you are unsure about the most appropriate person to contact, the School Teaching and Learning Office will always be happy to advise you. Beyond the School, the University operates disability-support, counselling, and careers services.

4.1 The School Teaching and Learning Office

The School's Teaching and Learning Office is based on the 1st floor of the Schuster building and provides general and administrative support to all Undergraduate students.

The Undergraduate Team provide support on degree programmes, course units, room bookings, timetabling, examinations and any administrative support to do with your study. If you would like to contact the Undergraduate Team, please email **physics@manchester.ac.uk.** For further details, please see the Undergraduate section on the **School Intranet.**

The Student Support and Welfare team should be your first point of contact if you are experiencing any problems to do with your welfare. If you would like to make an appointment to meet with a member of our Student Support and Welfare Team, please email **physics.support@manchester.ac.uk.** For further details, please see the Student Support and Welfare section on the **School Intranet.** If you require advice on ill health affecting assessment and study, please see **Section 11. Student ill-health and other matters affecting work and assessment** for further details.

The School Student Experience Team should be contacted for matters relating to careers and employability, wellbeing, the PASS Scheme, student engagement, Student Rep meetings. or any other events the School may hold. If you would like to contact the Student Experience Team, please email **physics@manchester.ac.uk.** For further details, please see the Student Experience section on the **School Intranet.**

4.2 Personal Tutors

Each student is assigned a Personal Tutor at the beginning of the degree programme. The Personal Tutor advises on choosing course unit options and monitors progress throughout the degree programme. Four official meetings are scheduled each academic year: a meeting in registration week at the beginning of the academic year, a meeting to consider progress at the end of the first semester, a mid-year progress meeting in week four of the second semester, and an end of year meeting following the June examination period. However, at all times during the year, students should feel free to approach their Personal Tutors on matters affecting study. Please note that the Personal Tutor is also one of the academic tutors during the first year and so will see their tutees each week for that year.

4.3 Disability Advisory and Support Service

The Disability Advisory and Support Service (DASS) provides help and advice for students with specific learning difficulties, disabilities, sensory impairments, mental health difficulties and on-going medical conditions. The University follows a process of reasonable adjustments for students registered who are with DASS. A reasonable adjustment is a change of adaptation to the working environment that can remove or minimise the impact of the individual's impairment. What amounts to a reasonable adjustment depends on the circumstances – relevant issues include cost, effectiveness and practicality[2] are made for students who are registered with DASS. The DASS office is based on the Second Floor of University Place. Telephone: 0161-275-7512/8518; email - **dass@manchester.ac.uk**

The School's Disability Co-ordinator is Géraldine Garrabet, who can be contacted via the School Teaching and Learning Office (Telephone: 0161-275-4100 or email: **physics.support@manchester.ac.uk**). Géraldine is responsible for ensuring that special needs for any students are communicated to the University and staff in the School.

4.4 University Support Services

The University's counselling service offers confidential help with any personal issues affecting work, self-esteem, relationships, mental health and general well-being. **The Counselling Service** (0161-275-2864) is on the fifth floor of Crawford House. The **University Student Support website** has a useful compilation of advice and links to various services.

The Students' Union (Steve Biko Building, 0161-275-2947) provides advice on academic and welfare problems (advice.su@manchester.ac.uk). There is also a *Nightline* service run by students (nightmail@nightline.manchester.ac.uk).

4.5 Contact with other Academic Staff

If the problem is academic related and involves course choices, you should contact your **Personal Tutor** in the first instance. For questions specific to your degree programme, you may also need to talk to your **Programme Director**, see **Section on Senior Teaching and Learning Academic Team**. If you have other concerns about your studies or you need approval for a change of options, you should contact your Year Tutor. The Year Tutor is also the appropriate person to contact if you wish to request a change of personal tutor. Alternatively, if this is not possible, you may also contact the Director or Deputy Director of Teaching and Learning.

Students are welcome to contact informally any member of staff about teaching and learning. If they have problems in this regard, they should request an appointment via email. Email addresses are listed at the beginning of this handbook and are also available from the **staff and student directory** on the University website.

4.6 Careers Service

The Careers Service provides information and guidance on career planning to all students and postgraduates during their course and for up to three years following graduation. In addition to the Careers Resource Centre library, students can obtain individual careers advice at any stage of their university career, from work experience to company internships, from full-time employment to further study, both in

[2] **Reasonable adjustments** are changes to the work environment that allow people with disability to work safely and productively. Under the Equal Opportunity Act 2010, 'disability' includes: physical, psychological or neurological disease or disorder, illness, whether temporary or permanent.

the UK and overseas. **The Careers Resource Centre** is in The Atrium, 1st floor, University Place and is open weekdays from 9.00 am to 5.00 pm (0161-275-2829).

There are also weekly careers appointments run in-School by our dedicated Careers Consultant, offering guidance on all things Career related, you can book in for:

- Applications Advice, to go over documents,
- Careers Meetings, for longer discussions covering PG study, career inspiration, LinkedIn, CVs, interviews, assessment centres and more,
- Interview Simulations, to hone your skills ahead of a real interview.

4.7 References

Personal Tutors will normally provide a reference for students who require one for a job or further study. They should always be contacted in advance; it is very helpful to provide the tutor with a CV and a brief statement about reasons for applying for the position. Other members of staff who have had significant contact with the student, for instance second year tutors and project supervisors, will usually also be happy to provide a reference, but again they should be asked in advance.

5. Course Review

A number of mechanisms are in place to monitor and to improve learning and teaching. The Year Tutors for each year of the course hold regular meetings in which teaching is reviewed by tutors, lecturers and student representatives. Students have academic tutors and personal tutors who can help resolve problems and pass on suggestions for improvement in teaching. Finally, students and staff are encouraged to bring problems and to make suggestions for improvement to the following committees and members of staff with special responsibilities for teaching (see sections at the beginning of this handbook for a list of staff currently in these roles).

5.1 Physics Students Representatives Committee

The student body elects a committee of fellow students to represent student interests. Student representatives attend meetings of the School Board and of the main committees which deal with teaching matters. They play an active role in the regular teaching review meetings of tutors, lecturers and student representatives chaired by the Year Tutors. In addition, joint meetings of staff and student representatives are held to consider issues of broad concern.

5.2 Course Unit Surveys

Lectures and laboratory work are monitored by Course Unit Surveys, which are completed each semester. They allow students to provide their opinion on the strengths and points of possible improvement on their course units and so provide valuable information to individual teachers and to the school as a whole. **The summaries** are available to help other students when they are deciding on their course unit selection. The full reports are reviewed by the Lecturers who then provide a **response** that is published as “course review” alongside the exam feedback.

5.3 National Student Survey (NSS)

Each year, graduating students are asked about their experiences on their degree course, via the National Student Survey (NSS). The University, the School of Physics and Astronomy, HEFCE (the universities’ funding body) and the government all put great weight on the results of this survey, and they are also made available for future UCAS applicants.

All students are therefore urged to participate in the NSS if you are asked to do so. As with the Course Unit Surveys, views expressed there are used to improve the course. There are some **notes available** that may help you to understand the survey questions. Please read them before completing the survey.

5.4 Year Tutors and Teaching Review Meetings

Year Tutors are responsible for the quality and organisation of teaching in each year of the degree programme. They also collate the example sheets for tutorials. Twice a semester they chair Teaching Review meetings attended by lecturers, tutors and student representatives. These meetings give all students the opportunity to provide feedback to course unit lecturers via their representatives, who will ask for comments in advance. Notes and actions are taken by the Teaching and Learning Office, and minutes are posted **online**.

5.5 Year Laboratory Tutors

Year Laboratory Tutors are responsible for the quality of laboratory teaching and assessment in each year of the degree programme. The Year Laboratory Tutors report to the Laboratory Committee.

5.6 The Laboratory Committee

This committee organises and develops the laboratory work component of the teaching programme. Its membership consists of staff in charge of laboratory teaching in each year of the degree, staff with responsibility for particular laboratories and the Head of Student Representatives.

5.7 Teaching Quality and Lecture Allocation Group

This committee (chaired by the Director of Teaching and Learning) has the responsibility for promoting good practice and high quality teaching in the School. The committee organises peer review of teaching with the aims of improving the quality of the course units, reviews the results of student feedback and develops the teaching skills of staff.

It also assigns the major teaching duties in the school. Its remit is to ensure that course units are taught effectively by appropriate staff and to develop the teaching experiences of staff.

5.8 The Teaching and Learning Committee

This committee is responsible for the content, structure and organisation of the taught degree programmes. Its membership comprises the Director of Teaching and Learning (in the chair), the Head of School, the Year Tutors, the Chair of Examiners, the Programme Directors, the Chair of the Laboratory Committee, the Recruitment and Admissions Directors, Student Experience Manager and Undergraduate Manager, and four student representatives. Minutes are posted **online**.

5.9 External Examiners' Reports

External Examiners' reports relating to this programme will be shared with student representatives at the Teaching and Learning Committee, where details of any actions carried out by the School in response to the External Examiners' comments will be discussed. Students should contact their student representatives if they require any further information about External Examiners' reports or the process for considering them.

5.10 The School Board

The School Board meets several times each year and provides a forum for the discussion of any matter relevant to the school, including teaching. All full-time members of the academic staff are members of the Board. Representatives of students, technical staff and administration staff attend meetings of the Board.

5.11 The Institute of Physics (IoP)

The Institute of Physics is the Professional body that accredits all of the undergraduate degree programmes in Physics at the University of Manchester to ensure quality assurance of teaching and degree programme content. The School of Physics and Astronomy was accredited by the Institute of Physics in November 2016. The accreditation is due for renewal in 2021.

6. Learning Resources

6.1 Blackboard

Blackboard is the University-wide virtual learning environment. Each course unit has a Blackboard site. Information about laboratory and project procedures are similarly available in Blackboard. In addition the **UG Virtual Common Room** in Blackboard contains links to past exam papers, lecture timetables and forms, as well as other useful links.

Examples sheets and their model answers for most courses are made available electronically on Blackboard.

Useful Resources in Blackboard

- **Mathematical Formulae**
- **Computing**
- **Table of Constants**

6.2 The University of Manchester Library

The University Library is the largest non-legal deposit academic library in the United Kingdom, and includes extensive collections in physics, astronomy and related subjects. Students, staff and researchers at The University of Manchester also enjoy access to an abundant virtual library of electronic resources, 24 hours a day, throughout the year.

The University Library consists of a large central facility on the main campus (the Main Library), together with several satellite libraries (including the School's own Braddick Library). The **Main Library** is situated at the end of Burlington Street, just a few minutes' walk from the School of Physics and Astronomy, and houses the principal collections for science and other subjects. The **Braddick Library** primarily serves taught course students from the School of Physics and Astronomy, and is located within the School on the first floor of the Schuster Building. The Braddick Library supplements the Main Library's provision, and includes a Recommended Book Collection containing recommended reading for courses, a Teaching Collection of books and reference works, and a self-service photocopying facility.

The University Library supports students with a comprehensive range of services. These include High Demand collections of the most heavily used materials, self-issue and self-return machines, online renewals and reservations through the library catalogue, online reading lists, self-service photocopying, document supply, and library and discipline-specific guides. A range of study facilities cater for a variety of study styles, including Group Study Rooms that can be booked in advance through the student portal. Several computer clusters offer access to over 240 networked computers, which are available during the Main Library's opening hours.

Study facilities also include the Alan Gilbert Learning Commons building on Oxford Road.

The **University Library's website** provides detailed information about its services, enables access to the library catalogue, and delivers a wealth of electronic resources that can be used remotely. The relevant **physics-specific pages** offer advice and access to resources for physicists and astronomers. Resources include databases that support literature searching by identifying references to relevant publications, as well as electronic journals, electronic books and electronic reference materials (such as handbooks and data compilations, encyclopedias and dictionaries) that enable access to full text publications.

The University Library is actively working to ensure that all students with special needs have full access to all library resources and services. The University Library has a designated Disability Support Officer, if you require further information on this please visit the **website**.

Other informal areas of study in the School include:

- First floor of the Schuster building
- Braddick Library 'Quiet Area' on the first floor of the Schuster building
- First floor of the Schuster Annexe

Students in the 3rd and 4th year have out of hours access to the buildings, provided they complete the necessary Out of Hours training on **Blackboard**.

6.3 Physics Help Service

Help with problems in most areas of Physics and Mathematics is available in the Braddick Library for two hours each week (more often during exams), and times are listed **here**.

6.4 Computing Facilities

There is a PC cluster on the Mezzanine floor of the Schuster Building and also on the First Floor of the Schuster Annexe. The next nearest clusters are on the ground floor of the Chemistry Building and in the George Kenyon Building. A full list of clusters and their real-time availability is accessible from the **IT Services website**.

Wireless access for laptops and mobile phones is available in most of the Schuster Building.

Third floor teaching wing

This floor houses the main teaching computing facilities.

PCLAB1 contains forty PCs used mainly for teaching and computing courses and for general purpose use. There are also a limited number of wired connection points for laptops.

PCLAB2 contains twenty two PCs used for teaching computing and analogue hardware control and for general purpose use.

PCLAB3 is the fourth year cluster. This contains ten computers of which some contain dedicated software for the 4th year projects; three computers run dedicated experiments under the Linux operating system.

Fourth floor teaching laboratory

This laboratory mainly contains dedicated experiment control systems with some 26 machines. There are also four general purpose machines for word processing and data analysis.

Software in the teaching laboratories

The two main operating systems used are Windows and Scientific Linux. Scientific Linux has been adopted as the defacto standard Linux distribution throughout the Faculty of Science and Engineering. Common applications to support document preparation, web browsing, etc. are installed as standard. Specialist applications like Matlab, Mathematica, LabView, visualisation packages, etc. are installed as required.

The University also has a large portfolio of applications software that can be used by students on campus or in the halls of residence.

Printing

All clusters provide some form of networked printing which is charged at School standard central charges. Each student is credited with an allowance at the beginning of term by the School to cover some basic printing costs for the course. Any further printer credits required can be obtained from the printer credit kiosks in the Kilburn building.

7. Degree Programmes

Section 7.1 contains some information about the common core of Physics and options which is relevant to all students. Sections on all other programmes concentrate purely on what is unique to those programmes. They should be read in conjunction with the programmes structure tables of **Section 9. Structure of Degree Programmes by Year and Semester**

7.1 Physics [BSc, MPhys]

The study of physics is an attempt to understand everything that we can observe and measure in the Universe; from the infinitesimally small to the infinitely large. With such a large potential scope of study, the BSc and MPhys Physics programmes offer the widest choice of options of any of our degree programmes, enabling you to tailor your studies towards topics in which you are most interested.

As with other programmes, in your first and second years the core physics units will provide you with a strong foundation in classical physics, with topics including dynamics, waves, electromagnetism, thermodynamics and astrophysics & cosmology. At the same time, you are also introduced to concepts such as the unification of space and time, the wave-like behaviour of particles and the relation between entropy and disorder. This introduction is taught through course units in special relativity, quantum mechanics and statistical mechanics. The concepts taught in third year core are essential for the understanding of advanced topics in quantum physics, nuclear & particle physics, condensed matter and cosmology.

The 'core plus option' structure of the programme allows you to devote around 20% of your time in the first two years to topics chosen from a range of optional units. In the third year of BSc and for MPhys Years 3 and 4 combined, around 40% is option courses. You can typically choose a variety of subjects from different streams to suit your interests. Option choice is subject to timetabling constraints but we ensure that popular combinations of Physics options are always available. You should note that some course units have prerequisites – course units which must be studied before taking the course in question. Others have recommended study, course units which would be helpful to have studied but which are not required.

Note that some options are indicated with an (M) – these are the more mathematical course units. You should consider carefully your own capability in mathematical physics before choosing these units. For

example, in third year, you are given a choice between the more or less mathematical versions of the quantum and electromagnetism courses. The mathematical versions (PHYS30201 Mathematical Fundamentals of Quantum Mechanics and PHYS30441 Electrodynamics) should be taken by students with good mathematical skills, particularly those on the MPhys programmes who wish to keep open theoretical options in fourth year, such as PHYS40481 Quantum Field Theory (which also requires PHYS40202 Advanced Quantum Mechanics) and PHYS40771 Gravitation. Part of the second year course PHYS20762 Complex Variables and Vector Spaces covers prerequisite material for the Mathematical Fundamentals of Quantum Mechanics, and so this course should also be taken if possible by such students. Also note that in order to study theoretical particle physics in year 4 (PHYS40481 M and PHYS40682 M), it is necessary to take PHYS30201 (M), PHYS30441 (M), PHYS40222 and PHYS40202 (M) in year 3.

Manchester Physics has a strong component of laboratory work extending through the first, second and third year. The nature of the laboratory work gradually changes from shorter experiments to more open-ended experiments as your skills develop.

In the final year of the BSc you will write a dissertation on a specific topic in physics. In the fourth year of the MPhys course, you will tackle two projects; one in each semester. There is a choice from a large list of projects covering experimental, computer-based and theoretical topics, which in previous years have included simulating the human heart, the optical properties of graphene, quantum chaos, and calibration of the jet energy scales at the Large Hadron Collider.

7.2 Mathematics and Physics [BSc, MMath&Phys]

The Mathematics and Physics programme consists of modules taken from both the School of Physics and Astronomy ("Physics") and the School of Mathematics ("Maths"). It is however "owned" by Physics. Much useful information about the nature of study in mathematics and on their modules will be obtained on the **Maths website**. However this Handbook is the sole source of information on the Mathematics and Physics programme structure. Statements in documents from either School that are meant as general guidance and say "typically, students will..." may not be applicable to students on this programme. However the regulations on course structure, progression and degree classification in this handbook are carefully written to apply to this programme as well. Students will be assigned a Personal Tutor in Physics and an Academic Advisor in Maths, and both Schools have a Programme Director for the programme. For any academic matter specific to maths or physics the corresponding School will be the first port of call. But for wider issues involving the programme as a whole, or student welfare, the personnel of the School of Physics should be the first contact. The Programme directors in 2018/19 are **Dr Judith McGovern** (Physics) and **Dr Mike Simon** (Maths).

On the Physics side, the aim of the programme structure is to cover almost all of the core of physics. This is possible because the Physics programme contains a significant number of in-house maths modules as well as options that Maths/Physics students do not take, and also because Maths/Physics students do reduced lab. As a result the programme satisfies the requirements for IoP accreditation, and in addition it is possible to switch from Maths/Physics to Physics up to the start of third year. On the Maths side, Maths/Physics is only one of a number of joint programmes and most of the material considered core in the first two years is covered in two parallel strands, one specifically designed for joint honours. Maths/Physics students mostly take these courses, with some exceptions where the material of the single honours course is particularly relevant to Physics. It is not possible though to cover everything and second year students must choose one of two pathways (see later). A consequence of this is that switching from Maths/Physics to Maths is only possible before the start of second year, and then only subject to good

performance and undertaking some catch-up work on Probability. Each case is considered individually by Maths.

Mathematics modules may be 10, 15 or 20 credits in first and second year; in third year they are 10 credits and in fourth year, 15. For that reason the split of credits in a year is not always 60:60 across semesters. Students are never required to do more than 120 credits in a year (nor allowed to do less), but depending on option choices they are allowed to do 125 credits in third and/or fourth year.

Course codes in maths: each course unit has a course code MATH followed by a five-digit number. The first digit indicates the level of the course and the fifth digit indicates whether it runs in semester 1 or 2 (0 denotes a full year course unit). The subject area is indicated by the third digit for level 1 and 2 and the second digit for level 3 and 4 units, according to the following scheme: 0 General; 1 Pure (analysis); 2 Pure (algebra); 3 Logic; 4 Advanced Calculus; 5 Physical Applied; 6 Numerical Analysis; 7 Probability; 8 Statistics; 9 Discrete/Financial mathematics.

Programme structure: What follows is a descriptive guide, but it must be read in conjunction with the tables in **Section 9. Structure of Degree Programmes by Year and Semester**, which constitute the definitive programme regulations.

In **first year**, semester 1 the programme structure consists purely of prescribed units, two physics lecture courses and lab (30 credits in total) and two maths courses totalling 35 credits. In semester 2 there are three physics lecture (30 credits) and two maths courses totalling 25 credits.

First year students have one tutorial in Physics covering all their core courses. They also attend the physics workshops covering electromagnetism in second semester. In Maths, course units are supported by weekly supervisions of about 10 students, one per course (two per week). Normally, one of these will be taken by your Maths Personal Tutor. You will be set weekly exercises by the course lecturer, which should be handed in to your supervisor before the supervision class. Supervision work and attendance counts as 10% of the marks for the associated course unit. Most Maths units in all years, including all those taken by Maths/Physics students in years 1 and 2, have mid-semester tests or other continuous assessment that contribute typically 10-20% to the final mark. Students should be warned that these tests might take place in week 6, independent study week.

In semester 1, Physics students cover aspects of geometric optics in their Introduction to Astrophysics course. Maths/Physics students instead do a specially-designed experimental package PHYS10181L as part of lab.

In **second year,** students have to choose their maths stream (see below). They cover all Physics core lecture courses (except “Mathematics of Waves and Fields”): two in semester 3 and three in semester 4, and they do one semester of lab; which semester though depends on the choice of Maths stream. There are three compulsory maths courses totaling 40 credits and two more constitute the stream.

The two maths streams involve the choice either of “Algebraic Structures” I and II, or of “Metric Spaces” and “Fluid Dynamics”. The former combination explores abstract mathematical structures, and will appeal to you if you particularly enjoyed the Foundations of Pure Maths and Linear Algebra courses this year, and would later like to explore such topics as Group theory, Symmetries in Groups and Nature, Algebraic Number Theory and Galois Theory. The other combination is suitable if you want to keep your options open in both pure maths (leading to such courses as Topology, Fractal Geometry and Differential Manifolds) and applied maths (leading to the study of Elasticity and Wave Motion, for example). The course codes (see

above) indicate units in different years that are thematically related, and generally the second year units will be prerequisites for courses in the stream in subsequent years.

If after taking Algebraic Structures I, the follow-up course is considered inadvisable by the student and the Programme Director, Metric Spaces may be substituted. Other deviations from the recommended maths courses may be allowed for BSc candidates only, after consultation with their Programme Director and Year Tutor.

The material that Physics students cover in "Mathematics of Waves and Fields" is largely covered by Maths/Physics students in "Partial Differential Equations and Vector Calculus". This includes Fourier Series, but it does NOT include Fourier analysis. In the latter part of semester 3 the academic tutor will guide students to complete self-study material in this topic, in time for its use in the semester 4 Wave Optics course. This is not assessed except to the extent that it might occur on the Wave Optics exam.

Students have a tutorial in Physics covering the core subjects, while maths units all have larger-group tutorial classes.

In second and third year students undertake the non-credit-rated units "PHYS20811 Professional Skills", "PHYS30811 2nd Vacation Essay", and the general papers PHYS20240 and PHYS30210. In calculating the Physics year averages these are combined in a weighed average with all the credit-weighted PHYS modules taken (see **Section 8. Course Units**; external options from lists 6E count as Physics). The Maths year average is a simple credit-weighted average of the MATH modules taken. To determine the mark for the year (see **Section 12.4 Criteria for Degree Classification**) the two are combined with relative weighting determined by the credits (so usually 60:60 in second year, for instance). This ensures that the Maths modules have the same weighting in the year average for a Maths/Physics student as for a Maths student.

In **third year** there are 50 credits of free-choice Maths units, subject only to timetabling constraints and to students having met the prerequisites. There is a wide choice of units that require only the core that all students have already done, but some are dependent on the second-year stream. Students on the 4-year course are strongly advised to choose some of these latter subjects, as they in turn open up choices in fourth year, and should remember that they will have a second chance to take courses of more general interest. Even where third year courses are not be formal prerequisites for fourth year courses in the same stream they are likely to be helpful. In general students should plan ahead from second year onwards. Up to 20 credits of level-two material can be taken in third year so you may also take the opportunity to fill gaps and increase future choice, taking Introduction to Geometry, for instance, or Metric spaces if not already taken, or Classical Mechanics which covers much the same material as Lagrangian Mechanics in Physics. Maths allows third year students to take level 4 options in either semester if they have satisfied the prerequisites. A list of suitable courses is given below, but it is not exhaustive. See the Maths **list of course units offered** for more.

In Physics the choice is constrained and differs for the 3 and 4 year programmes; students on the latter can only choose from a restricted set of units. This is so that they will satisfy the prerequisites for enough courses in fourth year. Most students take a balance of core between both semesters, and also take "Introduction to Programming for Physicists" in semester 5. This is called "strand A". However students whose interests are in theoretical physics will want to take both Electrodynamics and "Mathematical Fundamentals of Quantum Mechanics" in semester 5, which they can do by following "strand B". In that case they take the Maths module "Problem-solving by computer". Again, MMath&Phys students should consider their fourth year options when planning their third year courses. (Note that PHYS20161 counts towards the 20 allowed level-2 credits).

All BSc students do a project or dissertation in either Maths or Physics. A lab module is an option for BSc students following "strand A".

"Mathematical Fundamentals of Quantum Mechanics" is a very suitable choice for Maths/Physics students on either strand. It relies on material on vector spaces that Physics students meet in a semester 4 option. Almost all of this is covered in first year Linear Algebra, but the exception is vector spaces over a complex field. Self-study materials are available for students to look at over the summer if they plan to take this course.

In **fourth year** the only compulsory units are the projects, one from Maths and one from Physics. Otherwise the main restriction is that at least 50 credits including the project are taken in each subject, and that across third and fourth years at least 120 credits of level 4 material, including projects, are taken. Most MMath&Phys students will take 20 credits of level 4 Physics in third year, so it is possible to take some level 3 options.

Fourth-year students choosing course units must have regard to the prerequisites. However in Physics they can be interpreted flexibly if equivalent material has been met in Maths units; "Maths of Waves and Fields" is a case in point and is never intended to exclude Maths/Physics students. If in doubt don't hesitate to contact the lecturer, who will know if Maths/Physics have taken these courses in the past. All fourth-year (M) courses are open to Maths/Physics students who have taken appropriate third year courses (usually strand B). Furthermore, in Maths courses may be listed as prerequisites when only a part of the material is required, and students who are willing to do some work over the summer will be OK. Speak to your Maths advisor or the course lecturer for further guidance.

Below is a table of third and fourth year Maths options. Students are responsible for checking the timetable for clashes. A one-hour lecture clash is allowed, but you should consider carefully how you will make up the material, noting that the availability of podcasts cannot be guaranteed (either for an entire course, or on individual days). Other options are available but have prerequisites which are not normally satisfied by Maths/Physics students; however for instance taking MATH33011 Mathematical Logic after some self-study of material from the last section of MATH20302 Introduction to Logic opens up several more fourth year options. Similarly students may be able to teach themselves enough probability to take certain courses. *Please note that the annotation "not available as a free choice unit" does not apply to students on this programme.*

Level 3	
MATH31001 Linear Analysis [1]	MATH20122 Metric Spaces
MATH32001 GroupTheory [2][3]	MATH20222 Introduction to Geometry
MATH32011 Commutative Algebra [2]	MATH20302 Introduction to Logic
MATH32071 Number Theory [2']	MATH20512 Classical Mechanics
MATH34001 Applied Complex Analysis	MATH31042 Fractal Geometry [1]
MATH34011 Asymptotic Expansions and Perturbation Methods	MATH31052 Topology [1'][3]
MATH35001 Viscous Fluid Flow [3]	MATH32032 Coding Theory [2]
MATH35021 Elasticity	MATH32052 Hyperbolic Geometry
MATH36041 Essential Partial Differential Equations	MATH32062 Algebraic Geometry [2]
	MATH34032 Green's Functions, Integral Equations and the Calculus of Variations
	MATH35012 Wave Motion
	MATH35032 Mathematical Biology
	MATH35082 Symmetry in Groups and Nature [2]
	MATH36032 Problem Solving by Computer
	MATH39032 Mathematical Modelling in Finance
Level 4	
MATH41061 Differentiable Manifolds [1'][10][11]	MATH40082 Computational Finance [6]
MATH42041 Noncommutative Algebra [2]	MATH41012 Fourier Analysis and Lebesgue Integration [1]
MATH42061 Representation and Characters of Groups [4]	MATH41022 Analytic Number Theory
M ATH42121 Galois Theory [2][4]	MATH42112 Lie Algebras [2]
MATH44041 Applied Dynamical Systems	MATH42132 Algebraic Number Theory [2][7]
MATH45061 Continuum Mechanics [5][8]	MATH42142 Analysis, Random Walks and Groups [4']
MATH46101 Numerical Linear Algebra	MATH45122 Transport Phenomena and Conservation Laws
MATH49111 Scientific Computing	MATH45132 Stability Theory [8]
	MATH46052 Approximation Theory and Finite Element Analysis
	MATH46132 Numerical Optimisation & Inverse Problems [9]

[1] Requires Metric Spaces
[1'] Metric spaces recommended
[2] Requires Algebraic Structures
[2'] Algebraic Structures useful
[3] Particularly useful for Y4
[4] Requires Group Theory
[4'] Group Theory useful
[5] Elasticity recommended
[6] Require Scientific Computing
[7] Requires Commutative Algebra
[8] Viscous Fluid Flow recommended
[9] Requires Numerical Linear Algebra
[10] Introduction to Geometry useful
[11] Topology usefu

7.3 Physics with Philosophy (3 and 4 years) [BSc, MPhys]

This programme offers a solid grounding in all aspects of physics, both theoretical and experimental. However, a substantial amount of laboratory work is replaced by lecture courses and project work in philosophy. The areas of philosophy you will explore in most detail are those relevant to the overlap with physics; namely the nature of scientific knowledge and the status of science as a means of achieving understanding. In the first two years the philosophy units are designed to provide a grounding in the basic ideas of philosophy, including in the first year the study of metaphysics and epistemology (what it means to describe reality and acquire knowledge of it), and basic concepts of ethics. In the second year this is developed by compulsory modules in the philosophy of science and in at least one other related area. The third year's philosophy units can be chosen from a list of options, typically including further study of concepts relevant to science such as metaphysics and formal logic; these can be chosen as a gateway to Master's level philosophy units in the fourth year.

Students on this programme take nearly all the same core physics units as the Honours Physics students, and follow the philosophy option stream. This degree also promotes areas of physics that complement the option stream in philosophy. For example, the physics unit Physics and Reality discusses issues such as the nature of space and time and the implications of quantum mechanics for determinism, and the nature of cause and effect.

Physics with Philosophy students have the same level of tutorial support as Honours Physics students, and additionally participate in seminar groups with a staff member from the **Centre of Philosophy**, for each philosophy unit. Students undertake about half the amount of laboratory work as Honours Physics students, and the philosophy-based units make up about 30% of the total study time.

In the fourth year of the MPhys programme, students have a substantial amount of project work in both subjects, in addition to specialist course units on topics such as the philosophy of emotions and intentionality, logical properties and consciousness, and more advanced course units in physics.

7.4 Physics with Astrophysics (3, 4 years) [MPhys, BSc]

The **Physics with Astrophysics (PwA)** degree programme is fully compatible with the Physics programme in the sense that PwA students take all Physics core courses and all PwA courses are available for Physics students as well. Therefore switching from PwA to Physics, or vice versa, is straightforward.

In the first year PwA students choose between Advanced Dynamics (PHYS10672) or Physics of the Solar System (PHYS10692). Both these courses appear as an option in year 2, so the other can be taken then if desired. **Neither PHYS10672 nor PHYS10692 is a formal pre-requisite for any course.** Physics of the Solar System (PHYS10692) would be beneficial for many of the astrophysics courses in later years, while Advanced Dynamics (PHYS10672) would be beneficial for the more theoretically minded students who are thinking of taking the course Gravitation (PHYS40771) in year 4.

In year 2 PwA students are more limited in their option courses compared to Physics students, since they take the Galaxies (PHYS20491) and Astrophysical Processes (PHYS20692) courses, building on the first year courses and strengthening their foundation in astrophysics for the third year astrophysics courses. Note that physics with astrophysics students can take Lagrangian Dynamics

(PHYS20401) if they wish in year 3. Lagrangian Dynamics is useful (and in some cases a pre-requisite) for the more theoretical courses, such as Gravitation (PHYS40771) in year 4. Physics with astrophysics students who take Lagrangian Dynamics will not do PHYS30511 Nuclear Fusion and Astrophysical Plasmas in year 3, although this course is available as an option in year 4.

There are laboratory experiments in years 1 to 3 directly related to astrophysics topics, where you can apply your knowledge from astrophysics lecture courses in practice. These experiments include "Orbits, stars and asteroids" (year 1), "Hydrogen gas in the galaxy" (year 2) and "Dark matter and exoplanet detection using microlensing" (year 3). You can analyse data taken with the 76-metre Lovell telescope in Jodrell Bank, personally use a 13-metre radio telescope to take measurements on pulsars, and run a number of experiments on the seven-metre telescope of the dedicated undergraduate radio observatory.

For MPhys students, your fourth year involves two projects, each running for a full semester. BSc students will write a dissertation. In both cases topics can be chosen from an extensive list which includes a wide range of astrophysical projects. Projects on astrophysical topics will count toward the credit requirements on astrophysics courses in year 4 (see the section on year 4 in the undergraduate handbook).

7.5 Physics with Theoretical Physics [BSc, MPhys]

These degree programmes provide the understanding of a broad range of physics that is needed by theoretical physicists. Additional mathematical and theoretical modules are part of the core for Physics with Theoretical Physics; to accommodate these, the amount of laboratory work is reduced.

In the first year, students take all Physics core courses, with the addition of PHYS10471 Random Processes and PHYS10672 Advanced Dynamics, which provide a range of theoretical tools that are helpful in later years.

During the second year, the module PHYS20401 Lagrangian Dynamics provides an elegant theoretical framework for classical mechanics, which can be generalized to classical field theories (including electromagnetism and general relativity) and quantum field theories, as explored later in fourth year. PHYS20672 Complex Variables and Vector Spaces develop mathematical tools that are of use throughout physics; for example, the material on vector spaces provides the mathematical underpinning for quantum mechanics (PHYS30201). In addition, students of Physics with Theoretical Physics refine their computational skills by undertaking a theoretical computing project, PHYS20872.

In the third year, the both degree programmes provide core modules on the mathematical fundamentals of quantum mechanics (PHYS30201) and further mathematical methods used in physics (PHS30672). Further theoretical modules are provided as core for MPhys students, or are available as options to BSc students.

In the fourth year, MPhys students all students undertake either one year-long research project or two one-semester projects. The extensive list of projects includes a wide range of theoretical and computational projects, but students may also choose to broaden their experience by undertaking an experimental project. There are no core lectures in year 4; the wide choice of lecture courses includes a number on modern theoretical areas of research.

7.6 Physics with Study in Europe (4 years) [MPhys]

This course combines a comprehensive study of physics with the opportunity spend one year studying in one of our partner universities in France, Germany, Spain, or Italy, gaining a working knowledge of a European language and experience of a different culture. You will be able to express a preference for your host university, and places will be allocated during the first semester of your second year.

In your **first year** you will study in Manchester, and you follow the core physics course units with the addition of a 20-credit language unit. Your language unit will typically include two lectures per week throughout the year, supplemented with language laboratories and tutorials as needed. The Language Centre, please see **Section 8.6 The LEAP (Language Experience for All) Programme** will help you identify the right language course for you in welcome week of your first semester.

During your **second year** (in Manchester), you will again follow the core physics units, and replace two optional units with a language package designed to continue your development. In addition to your normal weekly physics tutorial you typically also attend a weekly physics tutorial in the appropriate foreign language. These are usually given by a native speaker, and introduce the technical vocabulary. As studying abroad is challenging, the progression criteria in year 2 are more stringent than in the other Masters programmes, and students who do not meet these do not go abroad but are transferred to Physics. See **Section 12.2 Criteria for Progression on the MPhys and MMath&Phys Programme in Years 1, 2 and 3** for details.

You will spend your **third year** studying physics at a university in Europe, where you are expected to attend modules to a total of 60 ECTS credit points (equivalent to 120 credits in Manchester). Before your departure the Programme Director for Physics with Study in Europe will help you identify courses at the host university which best approximate the core physics taught in Manchester in the third year. This includes Quantum Mechanics, Nuclear and Particle Physics, and Electrodynamics (or Electromagnetic Radiation). Shortly after arrival you must complete a health and safety report. The Programme Director will stay in touch with your throughout the year abroad to advise you on academic matters (e.g. choice of modules abroad).

The list of possible destinations for current second year students is as follows. It may change for subsequent years:

Université Grenoble Alpes
Université Pierre & Marie Curie Paris
Universität Heidelberg
Freie Universität Berlin
Universidad Autónoma Madrid
Université de Lyon
Université Paris-Sud Orsay
Technische Universität München
University degli Studi di Trieste
Universidad de Cantabria Santander

After the completion of the year abroad you will write an end-of-year report. It is written in English, and made up of three parts.

- The first section (of about 1-2 pages) is a list of all the courses/projects/labs undertaken while abroad. For each you should write a few lines listing the major topics covered and the assessment undertaken, and a very brief comment on how easy or difficult you found the course. This section will provide an overview of what you did and what you achieved while you were abroad.

- For the second section you choose one major topic (perhaps half a course) that you studied while abroad and write an essay on that topic. It should show your understanding of the physics that you have learned, its importance and possibly some of its implications. It is perhaps similar to a vacation essay written by other students but should be roughly twice as long (3,000-4,000) words. The typical audience for the essay is other students of the same level as yourself (a 4th year Physics with Study in Europe student) but who did not attend the course.
- The third section should contain copies of your academic Erasmus documents, including certificate of attendance, transcript, so-called grade conversion forms etc. You will receive detailed guidance in due course.

Physics with Study in Europe students have three components to their year mark for year 3:

- A health and safety report, to be completed shortly after arrival (5%).
- The report, to be submitted on their return to Manchester (20%)
- Assessments conducted abroad (75%)

Exceptionally, if for good reason performance in the last component is poor, students may have it weighted at 50%. The report is then replaced by examinations in 4 core subjects (typically PHYS30101, 30151, 30141 and 40352), to be taken on return to Manchester, which will contribute 45%. The exam papers will be taken from the preceding three years and the marks on this element will be capped at 75%. This option cannot be used if work and attendance while abroad have been unsatisfactory; in that case students will fail the year and register for a BSc on their return.

You will return to Manchester for your **fourth year**, where you will take core courses from the third year if you were not able to find an appropriate equivalent abroad. You will take at least 90 Manchester credits worth of fourth-year courses. In semester 7 you normally attend a laboratory module for students returning from a year abroad. In exceptional cases this can be waived by the Programme Director, in this case you do an MPhys project instead. In semester 8 you do a 20-credit MPhys project. In addition you can choose course units from a large list of options in semesters 7 and 8, including a number from other Schools in the University.

7.7 Table of allowed Programme Changes

All programme changes need to be approved by the director of the programme you wish to change to, and may be subject to appropriate prior option choice and performance.

Programme to change	Deadline to change
Physics to Physics with Astrophysics	Start of any Semester
Physics with Astrophysics to Physics	Start of any Semester
Physics to Maths and Physics	Start of Year 1
Maths and Physics to Physics	Start of Year 1, 2 and 3
Physics to Physics with Theoretical Physics	Start of Year 1, 2 and 3
Physics with Theoretical Physics to Physics	Start of any Year
Physics to Physics with Philosophy	First 6 weeks of Year 1 (mid-November)
Physics with Philosophy to Physics	Start of any Year
Physics to Physics with Study in Europe	Start of Year 1 or Year 2
Physics with Study in Europe to Physics	Start of Year 1, 2 and 3

Transfer from the Mathematics and Physics joint honours programme into honours Mathematics is normally possible at the start of the second year, subject to good performance, but it cannot be guaranteed and will be dealt with by the School of Mathematics.

8. Course Units

The structures of the degree programmes in each year are set out in **Section 9. Structure of Degree Programmes by Year and Semester**.

Each year of each programme consists of 120 credits which are made up of compulsory course units, termed core, and any other units to be chosen, termed options. Some of the core units are common to all programmes; others are specific to a particular programme and are labelled "Additional core" in the tables.

In addition the following compulsory units are *not* credit rated (and so are not subject to regulations on minimum pass marks).

- **PHYS20811 / 20821 Professional Development including the First Vacation Essay**
- **PHYS20040 / 20240 Second Year General Paper**
- **PHYS30811 Second Vacation Essay**
- **PHYS30010 / 30210 Third Year General Paper**

However these marks *do* count towards the relevant end of year marks, with weightings as given under the relevant subsections. Thus for example when calculating the second year mark for a non-direct-entry Physics student, the marks for the 10 lecture courses (each out of 100), the marks for 20 credits of lab (out of 200), the marks for the general paper (out of 100) and the marks for PHYS20811 (out of 90) are added together and divided by 139.

8.1 Option Choice

Details on the number of optional units that can be chosen in the various degree programmes are given in **Section 9. Structure of Degree Programmes by Year and Semester;** the number is largest for the Physics degree programmes. A student's Personal Tutor is responsible for advising that a sensible combination of options is chosen. In non-standard cases i.e. options not listed in the UG Handbook or any option changes after the deadline of week 2, the approval of the Year Tutor and (except for Physics) the Programme Director is required. Students should not change options beyond the end of week 2 (this will only be allowed under exceptional circumstances.) If you have exceptional circumstances for changing your options, you should complete the **Change of Option Notification form** which should be submitted to the Teaching and Learning Office in person or via email **physics@manchester.ac.uk**

The policy of the school is to make available as many appropriate options as possible subject to the constraints of the timetable. However, an option may be withdrawn if fewer than fifteen students register for it.

In the 1st and 2nd year you cannot take options that clash.

In 3rd and 4th year, students are permitted to take options which clash, so long as the clash is no more than 1 hour per week; the **Option Clash form** should be completed and emailed to **physics@manchester.ac.uk**. However students should note that they are responsible for covering the missed material themselves, that the availability of on-line notes varies from units to unit and that podcasts cannot be guaranteed. Difficulties in covering missed material cannot be used as grounds for mitigation.

8.2 Changes in Course Unit Availability

When planning their studies, students should take note that changes occur in degree programmes and in the availability of course units. **Section 9. Structure of Degree Programmes by Year and Semester** details the current arrangements in each year of study. The tables list the course units which, barring unforeseen circumstances should be in place.

8.3 General Papers

General Physics Papers are an important part of the Honours Examinations system. Their aim is to ensure that at the time of graduation students should have a good grasp of basic physics principles across the whole of core physics. Each paper is taken at the end of the academic year.

The standard General Papers are worth the equivalent of 10 credits and the shorter versions taken by Maths/Physics, Physics with Philosophy and direct entrants are worth the equivalent of 6 credits. All marks are combined into the year average using these credit weightings. Hence they contribute to progression in the second year and in the third year of the Masters programmes, and to degree classification in all programmes. However they are zero credit-rated for progression purposes which means that they need not be resat if failed.

The general papers are among the more challenging examination papers in that they do not generally contain “bookwork”, and reward problem solving and the ability to synthesize knowledge from different areas of the curriculum. Students are strongly encouraged to prepare for them by practising past papers, and are supported in this by questions on the second year tutorial sheets special second year general paper classes and by dedicated third year examples classes.

The specific papers taken are as follows.

Standard Papers

These are three-hour papers comprising fifteen compulsory short questions. The best thirteen marks are used for assessment. The questions are drawn from all of core physics up to semester 3 (second year paper) or 5 (third year paper).

Shorter Papers

Students on Mathematics and Physics and Physics with Philosophy degree programmes, and students who entered year 2 or year 3 as direct entry students, take the shorter, two-hour, papers comprising ten compulsory short questions. The best nine marks are used for assessment. The questions are drawn from all of core physics (excluding astrophysics) up to semester 3 (second year paper) or 4 (third year paper)

Students who change from one of these programmes to the Physics programme prior to the end of second year will take the standard paper.

8.4 Professional Development and the Vacation Essays

All students in the second and third years are required to write a physics essay during the summer vacation to be handed in at the start of the first teaching week, which contributes to the marks for the coming year. These are called the first and second vacation essays, and they test students' ability to explain physical phenomena at a level suitable for their peers.

Titles will be circulated by the unit coordinators after Easter.

The First Vacation Essay is part of a larger unit PHYS20811 Professional Development which forms part of the assessment in the second year.

These units, though not credit-rated for progression, count in the mark for the second to third years respectively as follows:

- Professional Development (PHYS20811) has a weight corresponding to 9 credits.
- The Second Vacation Essay (PHYS30811) has a weight corresponding to 3 credits.

More details on these units can be found under the relevant unit specifications.

8.5 Options from other Schools

The programme structure tables mention suggested options from other subject areas such as Maths, Earth Science, Centre for the History of Science Technology and Medicine (CHSTM), Mechanical Aerospace and Civil Engineering (MACE), Economics, and the Manchester Enterprise Centre (MCEL). In principle where the structure of your programme allows some credits of external options any unit may be taken, subject to satisfying prerequisite and timetable constraints, and provided the level is appropriate for your year. However, permission of the year tutor and of the host school will be required if the option is not listed. The best source of information on external units is the "course unit information" section of the "My Learning" tab in **My Manchester;** searching by subject area (eg Economics) is often easier than by School.

There are also sets of course units, such as foreign languages, specifically designed to be taken by students from different programmes, which are not listed individually in the programme tables; these are covered in the next three subsections.

8.6 The LEAP (Language Experience for All) Programme

Foreign language courses - Offered as part of the University Language Centre's institution-wide language programme (LEAP), these courses are available to students from across the University and may be studied on a credit or on a non-credit basis to complement your degree. Currently there are 17 languages including the main international languages such as *French, Spanish, Arabic, Chinese, German*) but also others including *Japanese, Hebrew, Persian, Turkish*, offered at various levels. For more information on the full range of languages and levels that are available, please consult the University Language Centre website via the link given below.

Note that the course code (e.g. ULXXn0xys) indicates the language (XX) and the level (n). Pre-requisites are listed separately for each course.

Information about these and other available units is given on the **LEAP website.**

Most units are year-long units counting for twenty credits and are open to undergraduates, providing that they are taking the unit as an integral part of their degree. Because of the nature of language learning, 100% attendance is expected on these courses. Students may not normally register for a language course which is more than one level beneath their own, e.g. a level 1 course in third year. Exceptions are occasionally made where the student wishes to take the course for good reason (e.g. career-related) and the Year Tutor is satisfied that the course represents a sufficient academic challenge in the light of the student's prior knowledge of foreign languages.

Undergraduate students who do not have credits available but would still like to take a language course; can do so after payment of a fee. Please see Language Centre website for further information.

Registration of Physics Students:

First year students should register as soon as possible in Registration Week. Students should register in person in the **LEAP Office** in room WG.11 in the Samuel Alexander Building.

2nd and 3rd year students can register from April onwards either in person in the LEAP office or by post after downloading and completing a LEAP enrolment form. Lists for those students who have successfully registered by Registration Week should be posted in the Samuel Alexander Building outside the LEAP Office.

Class lists including first year students will be posted early in the first teaching week.

Students needing general advice on language course units should contact the Study in Europe Co-ordinator.

8.7 MBS Business and Management for all programmes (BMaP)

Business and Management for all Programmes (BMaP) is a suite of about 25 undergraduate business and management courses at varying levels offered by Manchester Business School. The courses are open to all undergraduate students across the University who are eligible to take ''free choice'' options as part of their degree structure, providing they meet the entry criteria for the course(s) concerned. Physics students may take units which are not more than one level below their own (e.g. first and second year students can take level 1 course, but third year students cannot.)

8.8 University College

The **University College** for Interdisciplinary Learning (UCIL) presents an opportunity for students to broaden their educational horizons. It offers courses that showcase the research and knowledge found at the University and encourages students to go beyond the boundaries of their degree programme. Examples include "Science, Technology and Democracy", "The Search for Extraterrestrial Life", "Current topics in Biology", "Leadership of Learning", Essential Enterprise" and "Digital Society". (Some CHSTM courses are also offered though the UCIL.)

The **Manchester Leadership Programme** is also part of UCIL; students complete 10 or 20 credits of taught material as part of their programme (which may be taken on-line), and in addition may complete a volunteering placement to qualify for a Bronze, Silver or Gold Award.

Students in Physics and Astronomy who have options in second and third year may take level 2 or 3 University College Courses, subject to timetable constraints.

8.9 Study Abroad (Excluding Study in Europe)

There are opportunities for a limited number of students to study abroad at an English-language university in their third year, as part of their Manchester degree. The Study Abroad programme is available to MPhys and MMath&Phys students on all degree programmes.

There are many benefits to studying abroad:

1. It is the opportunity of a lifetime
2. It helps you grow as a person
3. It gives you a new perspective on your subject area and on higher education
4. It helps you in the job market
5. It broadens your horizons

Physics students can apply to study abroad in third year. Most students apply to The University of California but students have on occasion gone to other partner universities, such as the National University of Singapore and universities in Canada. Exchanges are dependent on the availability of courses at the host university that match the Manchester core material. Available courses can change over time, and this may necessitate changes to the possible exchange partners.

Information about the Study Abroad programme is given at an open meeting in the School, during October. All second-year students are informed by email of the date of this meeting. The deadline for applications is normally in December, in the academic year before the intended exchange. Applications are made to the International Programmes Office of the University, who will allocate available places.

Students hoping to study abroad are advised to take PHYS20401 (Lagrangian Dynamics) and PHYS20672 (Complex Variables and Vector Spaces) if their programme structure allows it.

All applications need to be approved by the Academic Exchange Advisor. Approval depends on the proposed course of study, academic achievement, and tutorial attendance and performance.

The Study Abroad programme is academically challenging.

- The School requires an average grade for the core Physics modules in excess of 70%.
- The opinion of the academic tutors will normally be sought.
- All students going abroad in the third year are required to attend additional maths examples classes in the second semester of their second year, and satisfactory attendance and completion of coursework are required for approval to go abroad.
- The School reserves the right to withdraw a student from the exchange programme if the academic performance or tutorial attendance drops below these minimum levels at any time before the exchange.

- Students will also be withdrawn from the exchange if they fail to proceed on the MPhys programme, or if the School judges them to be at risk of failing the MPhys progression criteria during the year abroad.

Further information about administrative aspects of the exchanges may be obtained from the **International Programmes Office**.

8.10 Professional Placement (4th year MPhys)

Students registered on the MPhys Physics degree programme are eligible to go on a professional placement in their fourth year. This opportunity exists in the form of a 60-credit course unit, PHYS40811 Physics Professional Placement. A limited number of placements are available for third year students to apply for each year, and are advertised on the PHYS40811 Blackboard page (this can be viewed by third year students using online guest access). The placements may be located within a company or in an external research institution.

Students taking this course unit spend the first 12 weeks of Semester 7 on their placement, although can start earlier in the summer (placements can be up to 6 months duration). The work is project based and continually assessed. Note that students taking this course unit do not do an MPhys project. Further details of the assessment may be found **here**.

Students interested in going on a placement can find out more information during an introductory talk to third years in welcome week by the course co-ordinator. A more in-depth information session is also organised later in the first semester, usually during independent study week (the exact date will be advertised to third year MPhys students in advance).

8.11 Course Codes

Every Physics course has a code, usually of the form PHYSx0yzs, where s=0 for year-long modules such as lab, s=1 for first semester and s=2 for second semester. x indicates the level which usually corresponds to the year, y=0,1,2,3 indicate core, y=4,5,6,7&9 indicate options, y=8 is essay or project, and z (with some exceptions) is an indication of the subject area according to the following scheme: 0: classical and quantum mechanics, 1 optics, 2 particle and nuclear, 3 biophysics and medical, 4 electricity and magnetism, 5 thermal and solid state physics, 6 computing, 7 mathematical, 8 laboratory, 9 astronomy). Hence PHYS10352 is a first year, second semester core course in the area of thermal and solid state physics – namely Properties of Matter. Some level-four courses are taken by MPhys students in the second semester of third year; these are all courses which build on level-three courses already taken.

8.12 Core and Option Pathways

Stream	S1	S2	S3	S4	S5	S6	S7	S8
Classical and Quantum Mechanics	**Dynamics, Quantum Physics and Relativity**	**Vibrations and Waves**	**Introduction to Quantum Mechanics**		**Applications of Quantum Mechanics, Mathematical Fundamentals of Quantum Mechanics (M)**	Advanced Quantum Mechanics (M)	Quantum Field Theory (M)	**Physics of Fluids, Gauge Theories (M)**
Electricity and Magnetism	Light and Optics	**Electricity and Magnetism**	**Electromagnetism**		**Electromagnetic Radiation, Electrodynamics (M)**			
Theoretical Physics	Random Processes in Physics (M)	Advanced Dynamics (M)	Lagrangian Dynamics (M)	Complex Variables and Vector Spaces (M)	Introduction to Nonlinear Physics (M)		Advanced Statistical Physics (M)	
Condensed Matter Physics		**Properties of Matter**		**Statistical Mechanics, Fundamentals of Solid State Physics**	**Thermal Physics of Bose and Fermi Gases**	**Solid State Physics,** Semiconductor Quantum Structures	Frontiers of Solid State Physics	**Soft Matter Physics, Superconductors and Superfluids**
Nuclear Physics		Physics of Energy Sources			**Introduction to Nuclear and Particle Physics**	**Nuclear Physics,** Applied Nuclear Physics	Nuclear Structure and Exotic Nuclei	**Reactor Systems, Nuclear Forces and Reactions**
Particle Physics						**Particle Physics**	Frontiers of Particle Physics 1	**Frontiers of Particle Physics 2**
Astrophysics	**Introduction to Astrophysics and Cosmology**	Physics of the Solar System	Galaxies	Astrophysical Processes	Nuclear Fusion and Astrophysical Plasmas	**Cosmology,** Stars and Stellar Evolution Exoplanets	Radio Astronomy, Gravitation (M)	**Early Universe (M), Galaxy Formation**
Technological Physics and Photonics	Physics in Everyday Life, **Digital Electronics**	**Circuits**	**Amplifiers and Feedback**	**Wave Optics**, Introduction to Photonics	Lasers and Photonics		Laser Photomedicine, Frontiers of Photon Science	**Atomic Physics**
Mathematics	Mathematics 1	Mathematics 2	Mathematics of Waves and Fields	**Introduction to Logic, Fluid Mechanics Introduction to Financial Mathematics**	**Viscous Fluid Flow, Applied Complex Analysis**	**Mathematical Methods for Physics (M), Analytic Number Theory Wave Motion Mathematical Modelling in Finance Introduction to Logic**		

Stream	S1	S2	S3	S4	S5	S6	S7	S8
Computing & Data Analysis	**Computing and Data Analysis**	**Introduction to Data Science**	**Introductory to Programming for Physicists**	Computational Physics, Theory Computing Project		Object-Oriented Programming in C++, Quantum Computing		
Laboratory	**First Year Laboratory**	**First Year Laboratory**	**Second Year Laboratory**	**Second Year Laboratory,**	**Third Year Laboratory**	**Third Year Laboratory**		
Other Physics	**Special Topics in Physics**				**Dissertation**	Physics and Reality	**Project** Physics Professional Placement	Project
Earth and Atmospheric Science	Planet Earth	Introduction to Planetary Science	Atmospheric Physics & Weather	Earth Resources	Meteorology and Atmospheric Physics	Comparative Planetology, Climate and Energy		
Biological Science						Physics of Living Processes Physics of Medical Imaging,		**Biomaterials Physics**
History of Science	Science and the Modern World			Information Age		The Nuclear Age	Climate Change & Society	
Economics	Microeconomics	Macroeconomics	Environmental Economics		Operational Research,			
Business and Management	Fundamentals of Management	Fundamentals of Finance, Fundamentals of Management / Accounting	Strategy, Organisation and Competition, New Product Development and Innovation	Technology Strategy and Innovation, Organisations and Employment Etc.	Management, Technology and Innovation, Marketing Etc.	Strategy, Human Resource Management, Managing Projects Etc.		
Enterprise			Exploring Enterprise Tools and Techniques for Enterprise	Entrepreneurial Skills	Tools and Techniques for Enterprise	Advanced Technology Enterprise	Enterprise Strategy & Marketing	**Advanced Technology Enterprise**
Wider curriculum			**Professional Development** University College Courses (S3-S6)	University College Courses	Interdisciplinary Sustainable Development, University College Courses	University College Courses		

9. Structure of Degree Programmes by Year and Semester

The following pages outline the compulsory and option elements for each programme for each year of study for all the physics degree programmes for the current academic year. This structure may be modified in future academic years as a part of a process of curriculum review and development.

Continuing students should choose their options by early August, having consulted their personal tutor before leaving Manchester in June. Student's options are chosen in consultation with their personal tutor. Students are required to enter their options on the student system, by the end of the second teaching week.

Please note that it is the student's responsibility to check with the host school if external options are running.

Timetables for 2018-2019 – Stored in the UG Virtual Common Room area on Blackboard.

9.1 First Year – Semester 1

MPhys/BSc Programmes (These are the same in Y1 and Y2).

Students take 60 credits per semester [1] as specified below. All courses are 10 credits unless otherwise indicated.

Courses marked with (M) require a higher than average aptitude for maths.

Programme	PHYS10071	PHYS10101	PHYS10121	PHYS10191	Lab.	Additional Core	Option
Physics	✓	✓	✓	✓	✓	×	See List
Physics with Astrophysics	✓	✓	✓	✓	✓	×	See List
Physics with Study in Europe	✓	✓	✓	✓	✓	Language Course[2]	×
Physics with Theoretical Physics	✓	✓	✓	✓	✓ not 10180E	PHYS10471(M)	×
Physics with Philosophy	✓	✓	✓	×	✓ not 10180E, incl 10181B & 10181L	PHIL10021 (20 credits)	×
Mathematics and Physics [1]	×	✓	✓	×	✓ **not 10180E, incl 10181B & 10181L**	**MATH10111 (15 credits) MATH10121 (20 credits)**	×

Physics Core Courses	
PHYS10071	Mathematics 1
PHYS10101	Dynamics
PHYS10121	Quantum Physics and Relativity
PHYS10191	Introduction to Astrophysics and Cosmology
PHYS10180	First Year Laboratory (Double unit S1 & S2, 20 credits)
PHYS10280	First Year Laboratory *Single unit S1 only 10 credits)
	Including:
PHYS10181B	Computing and Data Analysis
PHYS10180E	Digital Electronics
PHYS10181F	Special Topics in Physics
PHYS10181L	Light and Optics (Philosophy and Mathematics and Physics)

Additional Core	
PHYS10471(M)	Random Processes in Physics
MATH10111	Foundations of Pure Mathematics (15 credits)
MATH10121	Calculus and Vectors (20 credits)
PHIL10021	Introduction to Ethics (20 credits)

Additional Programme Information

[1] Mathematics and Physics: Students take 65 credits in semester 1 and 55 credits in semester 2.

[2] Physics with Study in Europe: Students take a language course appropriate in level to their initial knowledge of the language. LEAP courses are 10 credits in S1 and 10 credits in S2. Students in Physics with Study in Europe who begin with limited language skills may have to do extra work to reach the appropriate level by the end of first year. Students who have already reached the appropriate standard will be excused the language course and will be required to choose alternative course units.

S1 Options List

Students with an option choose 1 course from the following and are responsible for checking that they fulfil any course pre-requisites and that any external options don't clash with other courses.

Physics Option List 1	
PHYS10461	Physics in Everyday Life
PHYS10471(M)	Random Processes in Physics

External Option List 1E	
EART10111	Planet Earth; Its Climate, History and Processes
ECON10221	Microeconomics 1
HSTM10221	Science and the Modern World

Foreign Language Options

10 credits in S1 and 10 credits in S2 may be taken by honours Physics students.

See Section 8.6 The LEAP (Language Experience for All) Programme

Business and Management Options

See section 8.7 MBS Business and Management for all programmes (BMaP)

Tutorials and Workshops

All students (except Mathematics and Physics) have 2 tutorials, plus a 2 hour workshop, each week in both semesters. Supervision classes are available for Maths students. Physics with Philosophy students will be told about tutorial arrangements in Philosophy by the School of Social Sciences. Mathematics and Physics students attend 1 physics tutorial each week, and 1 hour of workshop in semester 2.

9.2 First Year – Semester 2

MPhys/BSc Programmes (These are the same in Y1 and Y2).

Students take 60 credits per semester as specified below. All courses are 10 credits unless otherwise indicated.

Courses marked with (M) require a higher than average aptitude for maths.

Programme	PHYS10302	PHYS10342	PHYS10352	PHYS10372	Lab.	Additional Core	Option
Physics	✓	✓	✓	✓	✓	×	See List
Physics with Astrophysics	✓	✓	✓	✓	✓	PHYS10672(M) or PHYS10692	×
Physics with Study in Europe	✓	✓	✓	✓	✓	Language Course	×
Physics with Theoretical Physics	✓	✓	✓	✓	×	PHYS10672(M)	See List
Physics with Philosophy	✓	✓	✓	✓	×	PHIL10622 (20 credits)	×
Mathematics and Physics[1]	✓	✓	✓	×	×	**MATH10212 (15 credits) MATH11222**	×

Physics Core Courses	
PHYS10302	Vibrations and Waves
PHYS10342	Electricity and Magnetism
PHYS10352	Properties of Matter
PHYS10372	Mathematics 2
PHYS10180	First Year Laboratory, including:
PHYS10180E	Digital Electronics
PHYS10182C	Circuits

Additional Core	
PHYS10672(M)	Advanced Dynamics
PHYS10692	Physics of the Solar System
MATH10212	Linear Algebra (15 credits)
MATH11222	Calculus & Applications
PHIL10622	Introduction to Metaphysics and Epistemology (20 credits)

Additional Programme Information

[1] Mathematics and Physics: See programme information in semester 1.

S2 Options List

Students with an option choose 1 course from the following and are responsible for checking that they fulfil any course pre-requisites and that any external options don't clash with other courses.

Physics Option List 2	
PHYS10622	Physics of Energy Sources
PHYS10672(M)	Advanced Dynamics
PHYS10692	Physics of the Solar System
PHYS10792	Introduction to Data Science

External Option List 2E	
EART10272	Introduction to Planetary Science
ECON10252	Macroeconomics 1

Foreign Language Options

10 credits in S1 and 10 credits in S2 may be taken by honours Physics students.

See Section 8.6 The LEAP (Language Experience for All) Programme

Business and Management Options

See section 8.7 MBS Business and Management for all programmes (BMaP)

Tutorials and Workshops (Refer to semester 1)

First Vacation Essay (part of PHYS20811/20821 Professional Development)

All students are required to write a physics essay during the summer vacation to be handed in at the start of the first teaching week of their second year.

9.3 Second Year – Semester 3

MPhys/BSc Programmes (These are the same in Y1 and Y2).

Students take 60 credits per semester as specified below. All courses are 10 credits unless otherwise indicated. Please note that PHYS20811/20821 is compulsory for all programmes. It is not credit-rated, but the mark counts towards the year mark and your degree result.

Courses marked with (M) require a higher than average aptitude for maths.

Programme	PHYS20101	PHYS20141	PHYS20161	PHYS20171	Lab.	Additional Core	Option
Physics	✓	✓	✓	✓	✓	×	See List
Physics with Astrophysics	✓	✓	✓	✓	✓	PHYS20491	×
Physics with Study in Europe	✓	✓	✓	✓	*[1]	PHYS20401(M) Language Course[1]	×
Physics with Theoretical Physics	✓	✓	✓	✓	✓ Not PHYS20181E	PHYS20401(M)	×
Physics with Philosophy	✓	✓	×	✓	✓ Not PHYS20181E	PHIL20261 (20 credits), PHYS20280	×
Mathematics and Physics[2]	✓	✓	×	×	***** **Not PHYS20181E**	**MATH20111, MATH20401 (20 credits)**	**PHYS20280 or MATH20201[2]**

*Note * indicates a choice of courses to be made.*

Physics Core Courses	
PHYS20101	Introduction to Quantum Mechanics
PHYS20141	Electromagnetism
PHYS20161	Introduction to Programming for Physicists
PHYS20171	Mathematics of Waves and Fields
PHYS20180	Second Year Laboratory (Double unit S3 & S4, 20 credits)
PHYS20181E	Amplifiers and Feedback
PHYS20280	Second Year Laboratory (S3 only, 10 credits)
PHYS20811	Professional Development (0 credits)

Additional Core and Programme-Specific Options	
PHYS20401(M)	Lagrangian Dynamics
PHYS20491	Galaxies
MATH20111	Real Analysis
MATH20201	Algebraic Structures 1
MATH20401	Partial Differential Equations and Vector Calculus (20 credits)
PHIL20261	Philosophy of Science (20 credits)

Additional Programme Information

[1] Physics with Study in Europe: Students who have already reached a satisfactory level in their language in 1st year and who are not doing a language course will do lab; otherwise a language course is taken instead.

[2] Mathematics and Physics: Students usually take EITHER MATH20201, MATH20212 and PHYS20280 (S4) OR PHYS20280 (S3), MATH20122 and MATH20502.

S3 Options List

Students with an option choose 1 from the following and are responsible for checking that they fulfil any course pre-requisites and that any external options don't clash with other courses.

Physics Option List 3	
PHYS20401(M)	Lagrangian Dynamics
PHYS20491	Galaxies
EART20281	Atmospheric Physics & Weather

External Option List 3E	
EART10111	Planet Earth: Its Climate, History and Processes
ECON20101	Environmental Economics 11A
HSTM10221	Science and the Modern World
MCEL10001	Exploring Enterprise
MCEL30001	Tools and Techniques for Enterprise

Foreign Language Options

10 credits in S1 and 10 credits in S2 may be taken by honours Physics students.

See Section 8.6 The LEAP (Language Experience for All) Programme

Business and Management Options

See section 8.7 MBS Business and Management for all programmes (BMaP)

University College Options

See Section 8.8 University College

Tutorials

All students attend one physics tutorial each week in both semesters. Physics with Study in Europe students also attend Physics in a Foreign Language tutorials as part of their programme in the second year. Physics with Philosophy students will be told about tutorial arrangements in Philosophy by the School of Social Sciences.

9.4 Second Year – Semester 4

MPhys/BSc Programmes (These are the same in Y1 and Y2).

Students take 60 credits per semester as specified below. All courses are 10 credits unless otherwise indicated.

Courses marked with (M) require a higher than average aptitude for maths.

Programme	PHYS20252	PHYS20312	PHYS20352	Lab.	Additional Core	Option
Physics	✓	✓	✓	✓	×	**2 from List**
Physics with Astrophysics	✓	✓	✓	✓	PHYS20692	**1 from List**
Physics with Study in Europe	✓	✓	✓	✓	Language Course, PHYS20672(M)	× [1]
Physics with Theoretical Physics	✓	✓	✓	×	PHYS20672(M), PHYS20872	**1 from List**[2]
Physics with Philosophy	✓	✓	✓	×	PHIL20212 (20 credits)	**MATH20302 or HSTM20282**
Mathematics and Physics	✓	✓	✓	*	**MATH20142**	**MATH20122 and MATH20502, or MATH20212 and PHYS20280**[3]

*Note * indicates a choice of courses to be made.*

Physics Core Courses	
PHYS20252	Fundamentals of Solid State Physics
PHYS20312	Wave Optics
PHYS20352	Statistical Mechanics
PHYS20180	Second Year Laboratory (Double Unit S3 & S4, 20 credits)
PHYS20280	Second Year Laboratory (S4 only, 10 credits)

Additional Core and Programme-Specific Options	
HSTM20282	The Information Age
PHYS20672(M)	Complex Variables and Vector Spaces
PHYS20692	Astrophysical Processes
PHYS20872	Theory Computing Project
MATH20122	Metric Spaces
MATH20142	Complex Analysis
MATH20212	Algebraic Structures II
MATH20302	Introduction to Logic
MATH20502	Fluid Mechanics
PHIL20242	20th Century Analytical Philosophy (20 credits)

Additional Programme Information

[1] Physics with Study in Europe: If students do not need to take a language course then they have an option.

[2] Physics with Theoretical Physics: May not take PHYS20762.

[3] Mathematics and Physics: See S3 notes.

S4 Options List

Students with an option or options choose from the following courses and are responsible for checking that they fulfil any course pre-requisites and that any external options don't clash with other courses. Not more than 20 credits of level 1 options may be taken in second year.

Physics Option List 4	
PHYS10622	Physics of Energy Sources
PHYS10672(M)	Advanced Dynamics
PHYS10692	Physics of the Solar System
PHYS10792	Statistical Methods
PHYS20612	Introduction to Photonics
PHYS20672(M)	Complex Variables and Vector Spaces
PHYS20692	Astrophysical Processes
PHYS20762	Computational Physics

External Option List 4E	
EART10262	Earth Resources
HSTM20282	The Information Age
MATH20222	Introduction to Geometry
MATH20302	Introduction to Logic
MATH20502	Fluid Mechanics
MATH20912	Introduction to Financial Mathematics
MCEL10002	Entrepreneurial Skills

Business and Management Options

See section 8.7 MBS Business and Management for all programmes (BMaP)

University College Options

See Section 8.8 University College

General Physics Paper

All students sit a General Physics Paper (PHYS20040/20240) in May/ June as part of the assessment for second year. The questions are based on the core physics units in Year 1 and in semester 3. Your tutor can help you to prepare for this paper.

Tutorials (Refer to Y2 semester 3)

Second Vacation Essay (PHYS30811)

All students are required to write a Physics essay during the summer vacation.

9.5 BSc Third Year – Semester 5

Students take 60 credits per semester as specified below. All courses are 10 credits unless otherwise indicated.

Courses marked with (M) require a higher than average aptitude for maths. [Courses marked (M) or (A) may count towards the MPhys fourth year requirements for Physics with Theoretical Physics or Astrophysics respectively, see MPhys 4th year syllabus]

Programme		PHYS30101 or PHYS30201(M)	PHYS30121	PHYS30151	PHYS30141 or PHYS30441(M)	Lab/ Dissertation[2]	Option [1] or Additional core
Physics		✓	✓	✓	×	✓✓	**1 from list 5 or 5(2) or 5E(2) or 5E(3)**
Physics with Astrophysics		✓	✓	✓	×	✓✓	**PHYS20401 or PHYS30511**
Physics with Theoretical Physics		PHYS30201(M)	✓	✓	×	✓ ✓ (Lab & Dissertation)	**PHYS30471(M) or MATH35001(M) or PHYS30441(M)**
Physics with Philosophy		PHYS30101	✓	✓	×	✓ (Lab)	**1 Philosophy Option (20 credits)**
Mathematics and Physics[3]	**Strand A**	PHYS30101 or PHYS30201(M) or PHYS30141 or PHYS30441(M)	✓	✓	[see col 1]	×	**PHYS20161, 20 or 25 credits of Mathematics Options**
	Strand B	**PHYS30201 (M)**	✓	✓	**PHYS30441(M)**	×	**20 or 25 credits of Mathematics Options**

Physics Core Courses	
PHYS30101	Applications of Quantum Physics or
PHYS30201(M)	Mathematical Fundamentals of Quantum Mechanics
PHYS30121	Introduction to Nuclear and Particle Physics
PHYS30151	Thermal Physics of Bose and Fermi Gases
PHYS30180	Third Year Laboratory (Double Unit 20 credits)
PHYS30280	Third Year Laboratory
PHYS30811	Second Vacation Essay (3 credits)
PHYS30880	BSc Dissertation

Additional Core and Programme-Specific Options	
PHYS20161	Introduction to Programming for Physicists
PHYS20401	Lagrangian Dynamics
PHYS30441(M)	Electrodynamics
PHYS30471(M)	Introduction to Nonlinear Physics
PHYS30511	Nuclear Fusion and Astrophysical Plasmas
MATH35001	Viscous Fluid Flow

Additional Programme Information

[1] You may not take more than 30 credits of external options, nor more than 20 credits of level 2 options, in year 3

[2] Laboratory. Each ✓ indicates 10 credits, either two 6 week lab experiments (PHYS30180/30280) or a 12 week BSc Dissertation project (PHYS30880). In semester 5 and semester 6 Physics and Physics with Astrophysics students do two lab experiments and a BSc Dissertation. The timing will depend on the dissertation chosen.

[3] The Maths options for Maths/Physics students and the rationale for Strand B are discussed in **Section 7.2 Mathematics and Physics [BSc, MMath&Phys]**

S5 Options List

Students with an option or options choose from the following courses and are responsible for checking that they fulfil any course pre-requisites. Students can take courses with a one hour clash as agreed by the Year Tutor and Programme Director. Please fill out the **form** which needs to be signed by the Year Tutor and Programme Director.

Physics Options List 5:	
PHYS30141	Electromagnetic Radiation
PHYS30441(M)	Electrodynamics
PHYS30471(M)	Introduction to Nonlinear Physics
PHYS30511(A)	Nuclear Fusion and Astrophysical Plasmas
PHYS30611	Lasers and Photonics
EART30351	Meteorology and Atmospheric Physics
MATH35001	Viscous Fluid Flow

Physics Options from Y2 List 5 (2):	
PHYS20401(M)	Lagrangian Dynamics

External Option List (level 3) 5E (3):	
MATH34001	Applied Complex Analysis(Prerequisite: PHYS20672)
MCEL30001	Tools and Techniques for Enterprise

Foreign Language Options

Studied as 10 credits in S5 and 10 credits in S6, but the course should normally be Level 2 or above

See Section 8.6 The LEAP (Language Experience for All) Programme

University College Options

See Section 8.8 University College

Example Classes

In semester 5 all students attend two examples classes each week to cover core courses. Attendance at these classes is monitored.

9.6 BSc Third Year – Semester 6

Students take 60 credits per semester. All courses are 10 credits unless otherwise indicated.

Courses marked with (M) require a higher than average aptitude for maths. [Courses marked (M) or (A) may count towards the MPhys fourth year requirements for Physics with Theoretical Physics or Astrophysics respectively, see MPhys 4th year syllabus]

Programme		Lab or Dissertation [2]	Core	Options [1]
Physics		✓	1 from list 6C	**4 from list 6C or 6 or 6E(2) or 6E(3)**
Physics with Astrophysics		✓	PHYS30392, PHYS40692	**3 from list 6C or 6 or 6E(2) or 6E(3)**
Physics with Theoretical Physics		×	PHYS30672(M), 1 from list 6C	**4 from list 6C or 6 or 6E(2) or 6E(3)**
Physics with Philosophy		Dissertation	1 Philosophy Option (20 credits), PHYS41702 1 from list 6C	**1 from list 6C or 6**
Mathematics and Physics[3]	**Strand A**	PHYS30880 or MATH30022	1 from list 6C or PHYS40202 or PHYS30280	**30 credits of Mathematics Options** [3]**,** **1 from (list 6C or 6, or 6E(2), or 6E(3)**
	Strand B	PHYS30880 or MATH30022	**MATH36032** 1 from list 6C or PHYS40202	**30 credits of Mathematics Options** [3]

Physics Core Courses	
PHYS30180	Third Year Laboratory (wks 1-6 or 7-12) (S5 & S6 20 credits)
PHYS30280	Third Year Laboratory (wks 1-6 or 7-12)
PHYS30880	BSc Dissertation

Additional Core and Programme-Specific Options	
PHYS30392(A)	Cosmology
PHYS30672(M)	Mathematical Methods for Physics
PHYS40202(M)	Advanced Quantum Mechanics
PHYS40692(A)	Stars and Stellar Evolution
PHYS41702	Physics and Reality
MATH30022	Project

Additional Programme Information

[1] You may not take more than 30 credits of external options, nor more than 20 credits of level 2 options, in year 3.

[2] Laboratory. Each ✓ indicates 10 credits, either a 6 week lab experiment (PHYS30180/30280) or a 12 week BSc project (PHYS30880). In semester 5 and semester 6 Physics and Physics with Astrophysics students do two lab experiments and a BSc Dissertation. The timing will depend on the dissertation chosen.

[3] The Maths options for Maths/Physics students and the rational for Strand B are discussed in **Section 7.2 Mathematics and Physics [BSc, MMath&Phys]**

S6 Options List

Students with an option or options choose from the following courses and are responsible for checking that they fulfil any course pre-requisites. Students can take courses with a one hour clash as agreed by the Year Tutor and Programme Director. Please fill out the **form** which needs to be signed by the Year Tutor and Programme Director.

Core for MPhys; list 6C:	
PHYS40222	Particle Physics
PHYS40322	Nuclear Physics
PHYS40352	Solid State Physics
PHYS30392(A)	Cosmology

Physics Option List 6:	
PHYS30632	Physics of Medical Imaging
PHYS30672(M)	Mathematical Methods for Physics
PHYS30732	Physics of Living Processes
PHYS30762	Object-Oriented Programming in C++
PHYS31692(A)	Exoplanets
PHYS40202(M)	Advanced Quantum Mechanics
PHYS40422	Applied Nuclear Physics
PHYS40692(A)	Stars and Stellar Evolution
PHYS40712	Semiconductor Quantum Structures
PHYS41702	Physics and Reality
EART30362	Climate and Energy
MATHS35012	Wave Motion

External Option List 6E (2):	
HSTM20282	The Information Age
MATH20302	Introduction to Logic

External Option List 6E (3):	
COMP39112	Quantum Computing
EART30232	Comparative Planetology
HSTM31212	The Nuclear Age
MATH39032	Mathematical Modelling in Finance
MCEL30002	Tools and Techniques for Enterprise
MCEL30012	Advanced Technology Enterprise (follow-on from MCEL30001)
MCEL30022	Interdisciplinary Sustainable Development

Foreign Language Options

Study of a foreign language as 10 credits in S5 and 10 credits in S6, but the course should normally be Level 2 or above

See Section 8.6 The LEAP (Language Experience for All) Programme

University College Options

See Section 8.8 University College

General Physics Paper

All students sit a General Physics Paper (PHYS30010/30210) in May/ June as part of the final examinations. The questions are based on the core physics units in Year 1, Year 2 and semester 5.

Examples Classes

In semester 6 students attend two examples classes each week, one covering core courses and one covering general physics. Attendance at these classes is monitored.

9.7 MPhys Third Year – Semester 5

Students take 60 credits as specified below. All courses are 10 credits unless otherwise indicated.

Courses marked with (M) require a higher than average aptitude for maths. [Courses marked (M) or (A) may count towards the MPhys fourth year requirements for Physics with Theoretical Physics or Astrophysics respectively, see MPhys 4th year syllabus]

Programme		PHYS30101 or PHYS30201(M) [2]	PHYS30121	PHYS30151	PHYS30141 or PHYS30441(M) [2]	Lab	Option [1] or Additional core
Physics		✓	✓	✓	✓	✓	**1 from list 5 or 5(2)or 5E(2) or 5E(3)**
Physics with Astrophysics		✓	✓	✓	✓	✓	**PHYS20401 or PHYS30511**
Physics with Theoretical Physics		PHYS30201(M)	✓	✓	PHYS30441(M)	✓	**PHYS30471(M) or MATH35001(M)**
Physics with Philosophy		PHYS30101	✓	✓	✓	✖	**1 Philosophy Option (20 credits)**
Physics with Study in Europe [4]		✖	✖	✖	✖	✖	✖
Mathematics and Physics[3]	**Strand A**	PHYS30101 or PHYS30201(M) or PHYS30141 or PHYS30441(M)	✓	✓	[see col 1]	✖	**PHYS20161, 20 or 25 credits of Maths Options**
	Strand B	**PHYS30201(M)**	✓	✓	**PHYS30441(M)**	✖	**20 or 25 credits of Mathematics Options**

Physics Core Courses	
PHYS30101	Applications of Quantum Physics
PHYS30201(M)	Mathematical Fundamentals of Quantum Mechanics
PHYS30121	Introduction to Nuclear and Particle Physics
PHYS30141	Electromagnetic Radiation
PHYS30151	Thermal Physics of Bose and Fermi Gases
PHYS30180	Third Year Laboratory (wks 1-6 or 7-12)(Double Option S5 & S6, 20 credits)
PHYS30280	Third Year Laboratory (wks 1-6 or 7-12)
PHYS30441(M)	Electrodynamics
PHYS30811	2nd vacation essay (3 credits)

Additional Core and Programme-Specific Options	
PHYS20161	Introduction to Programming for Physicists
PHYS20401	Lagrangian Dynamics
PHYS30471(M)	Introduction to Nonlinear Physics
PHYS30511(A)	Nuclear Fusion and Astrophysical Plasmas
MATH35001	Viscous Fluid Flow

Additional Programme Information

[1] You may not take more than 30 credits of external options, nor more than 20 credits of level 2 options, in year 3.

[2] Students should consult **Section 7.1 Physics [BSc, MPhys]** about the choice of the more or less mathematical version of the quantum and electromagnetism courses.

[3] Mathematics and Physics The rationale for Maths/Physics students to follow Strand B are discussed in **Section 7.2 Mathematics and Physics [BSc, MMath&Phys]**

[4] Physics with Study in Europe students study abroad during their third year. Students are required to produce a year abroad report.

S5 Options List

Students with an option or options choose from the following courses and are responsible for checking that they fulfil any course pre-requisites. Students can take courses with a one hour clash as agreed by the Year Tutor and Programme Director. Please fill out the **form** which needs to be signed by the Year Tutor and Programme Director.

Physics Options List 5:	
PHYS30141	Electromagnetic Radiation
PHYS30441(M)	Electrodynamics
PHYS30471(M)	Introduction to Nonlinear Physics
PHYS30511(A)	Nuclear Fusion and Astrophysical Plasmas
PHYS30611	Lasers and Photonics
EART30351	Meteorology and Atmospheric Physics
MATH35001	Viscous Fluid Flow

Physics Options from Y2 List 5 (2):	
PHYS20401(M)	Lagrangian Dynamics

External Option List (level 3) 5E (3):	
MATH34001	Applied Complex Analysis(Prerequisite: PHYS20672)
MCEL30001	Tools and Techniques for Enterprise

Foreign Language Options

Study of a foreign language as 10 credits in S5 and 10 credits in S6, but the course should normally be Level 2 or above.

See Section 8.6 The LEAP (Language Experience for All) Programme

University College Options

See Section 8.8 University College

Example Classes

In semester 5 all students attend two examples classes each week to cover core courses. Attendance at these classes is monitored.

9.8 MPhys Third Year – Semester 6

Students take 60 credits per semester. All courses are 10 credits unless otherwise indicated. Courses marked with (M) require a higher than average aptitude for maths. [Courses marked (M) or (A) may count towards the MPhys fourth year requirements for Physics with Theoretical Physics or Astrophysics respectively, see MPhys 4th year syllabus]

Programme		Lab	Core	Options [1]
Physics		✓	All (4) from list 6C	**1 from list 6 or 6E(2) or 6E(3)**
Physics with Astrophysics		✓	PHYS30392, PHYS40692 + 2 from list 6C	**1 from list 6C or 6 or 6E(2) or 6E(3)**
Physics with Theoretical Physics		×	PHYS40202(M), PHYS30672(M), PHYS40352 + 2 from list 6C	**1 from list 6C or 6 or 6E(2) or 6E(3)**
Physics with Philosophy		✓	1 Philosophy Option (20 credits), PHYS41702 + 2 from list 6C	×
Physics with Study in Europe [3]		×	×	×
Mathematics and Physics[2]	**Strand A**	* (see Core)	3 from (list 6C or PHYS40202(M) or Lab)	**30 credits of Mathematics Options (3 x 10 level 3, or 2 x 15 level 4)**
	Strand B	×	**MATH36032, PHYS40202(M) and 1 from list 6C**	**30 credits of Mathematics Options (3 x 10 level 3, or 2 x 15 level 4)**

Physics Core Courses	
PHYS30180	Third Year Laboratory (wks 1-6 or 7-12) (S5 & S6 20 credits)
PHYS30280	Third Year Laboratory (wks 1-6 or 7-12)
PHYS30392(A)	Cosmology
PHYS40222	Particle Physics
PHYS40322	Nuclear Physics
PHYS40352	Solid State Physics

Additional Core and Programme-Specific Options	
PHYS30672(M)	Mathematical Methods for Physics
PHYS40202(M)	Advanced Quantum Mechanics
PHYS40692(A)	Stars and Stellar Evolution
PHYS41702	Physics and Reality
MATH36032	Problem Solving by Computer

Additional Programme Information

[1] You may not take more than 30 credits of external options, nor more than 20 credits of level 2 options, in year 3.

[2] Mathematics and Physics The rationale for Maths/Physics students to follow Strand B are discussed in **Section 7.2 Mathematics and Physics [BSc, MMath&Phys]**

[3] Physics with Study in Europe students study abroad during their third year. Students are required to produce a year abroad report.

S6 Options List

Students with an option or options choose from the following courses and are responsible for checking that they fulfil any course pre-requisites. Students can take courses with a one hour clash as agreed by the Year tutor and Programme Director. Please fill out the **form** which needs to be signed by the Year Tutor and Programme Director.

Core for MPhys; list 6C	
PHYS40222	Particle Physics
PHYS40322	Nuclear Physics
PHYS40352	Solid State Physics
PHYS30392(A)	Cosmology

Physics Option List 6:	
PHYS30632	Physics of Medical Imaging
PHYS30672(M)	Mathematical Methods for Physics
PHYS30732	Physics of Living Processes
PHYS30762	Object-Oriented Programming in C++
PHYS31692(A)	Exoplanets
PHYS40202(M)	Advanced Quantum Mechanics
PHYS40422	Applied Nuclear Physics
PHYS40692(A)	Stars and Stellar Evolution
PHYS40712	Semiconductor Quantum Structures
PHYS41702	Physics and Reality
EART30362	Climate and Energy
MATH35012	Wave Motion

External Option List 6E (2):	
ECON20090	Operational Research 1 (S5 & S6)
HSTM20282	The Information Age
MATH20302	Introduction to Logic

External Option List 6E (3):	
COMP39112	Quantum Computing
EART30232	Comparative Planetology
HSTM31212	The Nuclear Age
MATH41022	Analytic Number Theory [prerequisite: PHYS20672]
MATH39032	Mathematical Modelling of Finance
MCEL30002	Tools and Techniques for Enterprise
MCEL30012	Advanced Technology Enterprise (follow-on from MCEL 30001)
MCEL30022	Interdisciplinary Sustainable Development

Foreign Language Options

Study of a foreign language as 10 credits in S5 and 10 credits in S6, but the course should normally be Level 2 or above

See Section 8.6 The LEAP (Language Experience for All) Programme

University College Options

See Section 8.8 University College

General Physics Paper

All students sit a General Physics Paper (PHYS30010/30210) in May/ June as part of the final examinations. The questions are based on the core physics units in Year 1, Year 2 and semester 5.

Examples Classes

In semester 6 students attend two examples classes each week, one covering core courses and one covering general physics. Attendance at these classes is monitored.

9.9 MPhys Programmes Fourth Year – Semesters 7 and 8

Options

Fourth year options are in lists 7, 7E, 8 and 8E below. Students can take courses with a one hour clash with agreement from the year tutor and are responsible for checking that they fulfil any course pre-requisites. Options may also be chosen from lists 5, 5E(3), 6C, 6 and 6E(3), with the following constraints:
You must take at least 120 credits at level 4 in years 3 and 4 together. You may not take more than 30 credits of options from the external (E) lists in the fourth year.

Physics, Physics with Astrophysics and Physics with Theoretical Physics

Students do 60 credits per semester. All students do PHYS40181/2 (MPhys project, 20 credits) in each semester, leaving 40 credits of options in semester 7 and 8. To qualify for Physics with Astrophysics or with Theoretical Physics, at least 30 credits must be taken in year 4 marked with (A) or (M) for Astrophysics and Theoretical Physics respectively (may include designated projects). Students who have spent year 3 abroad must take at least 90 credits of level 4 courses in the fourth year. Students who opt for a professional placement (60 credits) undertake this for 1 semester in semester 7.

Physics with Study in Europe

Students do 60 credits per semester. The following are the usual rules, but they may be varied in exceptional circumstances by agreement with the Programme Director. In S7 students take PHYS40580 (level 4 version of third year lab, 10 credits) and in S8 PHYS40182 (MPhys Project, 20 credits), leaving 50 and 40 credits of options in semesters 7 and 8 respectively. As far as possible, gaps in third year core (usually Solid State and/or Particle and Nuclear Physics) must be covered. At least 90 credits of level 4 material must be taken in the fourth year.

Physics with Philosophy

Students do courses to a total credit rating of 120 or 125 for the year. Subject to that constraint, 55, 60 or 65 credits may be taken in each of S7 and S8. Students do either an MPhys Project (PHYS40181 or PHYS40182 (20 credits)) or a Philosophy Extended Essay (PHIL40000) (10 credits) in each of semesters 7 and 8, e.g., if PHYS40181 is taken in semester 7 then the extended essay must be taken in semester 8. In addition to project work Physics with Philosophy students choose one of the following:

(a) 2 units of level 6 Philosophy (30 credits) or 1 level 6 and 1 level 3 module (35 credits), and 6 units of Physics (60 credits)
(b) 2 units of level 6 Philosophy (30 credits), 1 unit of mathematical logic (15 credits) and 5 units of Physics (50 credits)
(c) 1 unit of level 6 Philosophy (15 credits), 2 units of mathematical logic (30 credits) and 5 units of Physics (50 credits).

Mathematics and Physics

Students do courses to a total credit rating of 120 or 125 for the year. Subject to that constraint, 55, 60 or 65 credits may be taken in each of S7 and S8. At least 50 credits in Physics and 50 credits in Mathematics over the course of the year must be taken, including MATH40011 *or* MATH40022 (Mathematics Project, 15 credits) and PHYS40181 *or* PHYS40182 (MPhys Project, 20 credits). (The two projects should be taken in different semesters). The remaining options are chosen from the lists 5, 6C, 6, 7 and 8, and Mathematics course units. PHYS30672 (M) (Mathematical Methods in Physics) cannot be taken.

Year 4 options are in lists 7, 7E, 8 and 8E. Options may also be chosen from lists 5, 5E (3), 6C, 6 and 6E (3), with the following constraints:

You must take at least 120 credits at level 4 in years 3 and 4 together;
You may not take more than 30 credits of options from the external (E) lists in year 4.
PHYS40811 Physics Professional Placement (60 credits). Students taking this option do not take the MPhys Project.

Option List 7:	
PHYS40411	Frontiers of Solid State Physics
PHYS40421	Nuclear Structure and Exotic Nuclei
PHYS40451	Superconductors and Superfluids
PHYS40481(M)	Quantum Field Theory
PHYS40521	Frontiers of Particle Physics 1
PHYS40571(M)	Advanced Statistical Physics
PHYS40591(A)	Radio Astronomy
PHYS40611	Frontiers of Photon Science
PHYS40631	Laser Photomedicine
PHYS40771(M,A)	Gravitation
PHYS40811	Physics Professional Placement (60 credits)

Option List 8:	
PHYS40622	Nuclear Forces & Reactions
PHYS40642	Atomic Physics
PHYS40652	Physics of Fluids
PHYS40682(M)	Gauge Theories
PHYS40722	Frontiers of Particle Physics 2
PHYS40732	Biomaterials Physics
PHYS40752	Soft Matter Physics
PHYS40772(M,A)	Early Universe
PHYS40992(A)	Galaxy Formation

Option List 7E:	
MCEL30011 (Level 4)	Advanced Technology Enterprise
MCEL30051	Enterprise Strategy and Marketing
HSTM33201	Climate Change and Society

Option List 8E:	
MCEL30012 (level 4)	Advanced Technology Enterprise
MACE31642	Reactor Systems (PHYS40422 is a pre-requisite)

10. Assessment and Examinations

The purpose of assessment is to encourage learning, to monitor progress, to determine eligibility to proceed to subsequent years, and to determine the class of the degree.

Failing the assessment can result in a number of consequences, which can vary by year. Further information can be found in section **12. Progression and Degree Classification Regulations**

10.1 Penalty for Late Submission of Continuous Assessment

The penalty for late submission of a report, essay or other continuously assessed work is as follows:

Work submitted after the deadline will be marked but the mark awarded will reduce progressively for each day, or part of a day, by which the work is late. The mark awarded will reduce by 10 percentage points per day, or part thereof, for 5 days, after which a mark of zero will be awarded.

Loss of marks is applied after conversion to a percentage; thus a piece of work graded at 60% which is up to one day late will be awarded 50%.

Unless specified to the contrary, this will apply to coursework for any unit with a component of continuous assessment. This includes lab reports, vacation essays, BSc dissertations and MPhys projects. Currently the only exceptions are lab interviews, PHYS20161 Introduction to Programming for Physicists and the "Mastering Physics" element of PHYS10101 Dynamics. The penalties associated with late submission in these are detailed in the corresponding syllabus pages.

Certain elements of continuous assessment must be passed, as judged before the application of the late penalty, in order to progress or graduate. In these cases it may be worth a student submitting work even beyond five days after the deadline. However this must be discussed first with the course leader.

For University documents on late submission please see the **Guidance on Late Submission** and the **Policy on Submission of Work for Summative Assessment**.

Students should consult the staff member responsible for the unit **in advance** if they anticipate problems in meeting deadlines. Extensions to deadlines as a consequence of illness or other problems are discussed in **Section 11.3 Illness and other problems affecting work, attendance and assessment**

10.2 Plagiarism and Collusion

Plagiarism is a serious offence, akin to cheating in exams. However past experience suggests that not all students realise what may constitute plagiarism. Please see the full **University guidance on the avoidance of plagiarism** and other forms of academic malpractice

Please note in particular that both the words and the ideas in a text are the copyright of the author. The following actions are therefore plagiarism:

- Plagiarism is presenting the ideas, work or words of other people without proper, clear and unambiguous acknowledgement.
- Copying someone else's words, even as little as a sentence or phrase;
- If you include too much copied text in quotation marks, you will be marked down. It is important that you use your own words;
- Paraphrasing someone else's words but following the structure of their text;
- Using striking analogies or metaphors from someone else's text

- Reproducing or copying images or figures without acknowledgment.
- Students should take care not to use 'self-plagiarism' which occurs where, for example, you submit work that you have presented for assessment on a previous occasion.

If in doubt, use quotation marks and give the source explicitly; merely including the source in the bibliography is not enough. However, do not quote heavily as this will affect your mark.

Collusion is where students, who are required to complete work individually, submit work that is based on the work of their fellow students. It is also an offence to allow your work to be used in this way, so you should for instance never share your lab reports with your fellow students (or put them on the web). Where students have legitimately worked together on an experiment or project, it is important that they ensure that only their own text is included in any final report (results can of course be shared). The prohibition on collusion is not meant to discourage students from studying together to support their learning.

Penalties will always be imposed; these can be as severe as the denial of a degree. Plagiarism, cheating in exams and other student misconduct are covered by **Regulation XVII**, "Conduct and Discipline of Students.

10.3 Examinations

In examination papers, a marking scheme is given as a guide to the relative importance of different parts of each question. Examiners follow these guidelines, but they may make small amendments in order to take into account how questions have been answered by the majority of students.

- No additional credit is given to students who answer more than the number of questions specified on the exam paper.
- If, for example, three questions have been answered (in whole or in part) when only two are required, then the last question attempted will be ignored.
- If you have attempted a question, but do not wish it to be marked, because you wish a later answer to be marked instead, you should cross through the unwanted attempt.
- Examiners will use their discretion to judge what constitutes an attempt.
- If students write more than one answer to the same question part, they should indicate which they wish to have marked, i.e. by putting a line through the other.
- If more than one alternative attempt remains undeleted, only the first attempt will be marked.
- Students are required to write the question numbers attempted on the front page of the answer book. The mark schemes are not available to students, but all past papers and numerical bottom-line answers are.

10.4 Examinations Schedule

Examinations are scheduled by the Examinations Team in the Student Services Centre. Exam timetabling is an extremely complex task given the large number of students taking a wide variety of courses in different schools and the necessity to avoid clashes for all students. Please note that this may mean you have exams scheduled on consecutive days or even two exams scheduled on one day (morning and afternoon). You should plan your revision and exam preparation well beforehand, and make sure that preparation for all papers is substantially completed before your first scheduled exam, as the intervals between exams may be short.

10.5 Registration for Examinations

IMPORTANT Please note: If you do not register for your course options by the Exams Office deadline your units will not appear on your exam timetable and you will not be officially registered for those exams.

10.6 Use of Calculators in Examinations

Simple calculators may be used in all physics examinations. However calculators with facilities for storing and retrieving information are not permitted. In particular, calculators with a full range of alphabetic keys (i.e. A-Z) are not permitted.

Any candidate found using an unauthorised calculator in an examination will be reported for suspected cheating and the calculator will be confiscated.

10.7 Religious Observance and Examinations

If you have strict religious requirements that may affect your attendance at examinations arranged centrally, you must complete the **Examination and Religious Observance form**. (Note that the major Christian festivals occur during vacations and hence are avoided automatically by examination periods.) You should then return the form to the Student Services Centre by dates that are published annually for each examination period. If you fail to submit a completed form to the Student Services Centre by the published date, we cannot accept responsibility if you are timetabled for an examination at a time when your religious requirements make it impossible for you to be present. The information about your faith is not given to anyone else, or used for any other purpose, or stored on computer.

Every effort will be made to accommodate your legitimate religious requirements, including discussing with your School whether it could make an alternative arrangement for the examination if you give adequate notice. However, if no reasonable alternative can be found, the University reserves the right to hold examinations on any days and times during examination periods. If that means you have to miss the examination, you will be required to take it when it is next held. This may involve an interruption of your programme and an extension to your period of study.

Please see the full **policy on Religious Observance**

10.8 Production of exam papers; marking, and moderation of exams

Exam Moderation Process

- The School undertakes a rigorous moderation process to ensure the high standard of our examination papers is maintained.
- The process is overseen by the Chief Examiner alongside the First and Second Year Examiners. The Chief Examiner is responsible for Years 3 and 4.
- The lecturer of each Course Unit is the Examiner and is thus responsible for setting and marking the exam that is taken by students registered on their course.

Pre-exam Moderation

Before examinations, the following steps take place in preparation of our exam papers:

1. The Examiner writes the exam paper and produce a set of model answers. Questions are set in accordance with the learning outcomes defined in the syllabus for the Course Unit.
2. Exam moderation panels are convened. In Years 1 & 2, these are chaired by the relevant Year Examiner and involve all relevant Examiners. In Years 3 & 4, exam sub-panels are formed with courses grouped by subject area. One of the Examiners acts as convenor. The chief examiner

overseas the moderation process.

3. The panel chairs/convenors arrange for exam papers to be checked by another academic staff member on the same panel. At this stage, checking is performed blind (i.e. without model answers) wherever possible. The checked paper is then corrected by the Examiner.
4. Following the checking process, each exam panel meets and all papers are read through and discussed in detail. Any problems or errors that are found at this stage are corrected by the Examiner before changes can be approved by the panel chair/convenor.
5. Exam papers are sent to the School's External Examiners for a third round of checking. Any additional corrections must then be approved by the Year/Chief Examiner before a final version of the paper is produced.

Post-exam Moderation

During and following the exam period, all scripts are marked and the marks for each Course Unit analysed. At all stages, the data are dealt with anonymously:

1. Exam papers are marked in accordance with the model answers. Examiners carefully check each page has been seen and the marks summed correctly, a process that is repeated by a member of the Teaching and Learning Support Team.
2. The marks for each Course Unit are sent to the Year/Chief Examiner who then analyse the mark distribution in comparison with those for other Course Units (for the same student cohort) and results from previous years. They report their findings to the relevant Exam Panel (see below).
3. Exam panels, one per year group (Years 1, 2, 3 & 4), meet and discuss the results of the marks analysis for each Course Unit in turn. Panel members include all relevant Examiners as well as members of the School with key Teaching and Learning roles. Occasionally, anomalies in the mark distributions are identified, in which case the panel will discuss and recommend the course of action to be taken by the Examination Board. This recommendation may involve re-scaling the marks for a course up or down by an amount deemed appropriate by the panel.
4. Following the Semester 1 process, *preliminary* marks are produced and released to students. These are subject to ratification by the Examination Board in June, together with the marks from Semester 2, before final marks are released. The External Examiners attend the final Examination Board meeting, assist us in determining the outcome of final-year students whose degree marks are borderline, and provide input to the overall process. Details of referred/deferred First and Second Year assessments are also produced at this stage, for re-examination in August.
5. Following the re-sit examination period, the Examination Board meets for one more time to decide on the outcome of students who had re-sit examinations.

10.9 Examination Board

Members of the Examination Board normally include your course unit lecturers, programme directors and one or more external examiners from other universities. It is the job of the Exam Board anonymously to review all the results and make decisions on the awarding of credit, who can resit exams, and who can progress to the next year. It is also the job of the Examination Board to decide who cannot continue and may leave the University with an exit award.

External Examiners are individuals from another institution or organisation who monitor the assessment processes of the University to ensure fairness and academic standards. They ensure that assessment and examination procedures have been fairly and properly implemented and that decisions have been made after appropriate deliberation. They also ensure that standards of awards

and levels of student performance are comparable with those in equivalent higher education institutions.

Some students will narrowly miss the threshold for a degree classification and the role of the Examination Board includes considering these candidates as set out in **Section 12. Progression and Degree Classification Regulations**

10.10 Examination Results

Overall examination results are posted on Blackboard. Individual course unit results are accessible through **My Manchester**.

10.11 Exam Script Viewing

The School offers students an opportunity to view their exam scripts to learn where they lost marks and could improve in the future. This is not a remarking opportunity. For further information see the **Exam Script Viewing guidance.**

10.12 Academic Appeal

If a student is concerned about their examination results, this can usually be resolved by contacting their Personal Tutor, or the relevant Year Tutor.

If a student wishes to make an **informal appeal**, this should be submitted in writing to the Undergraduate Manager, Suzanne Nightingale **suzanne.nightingale@manchester.ac.uk**

If the informal appeal is unsuccessful and a student decides to make a formal appeal against a decision of the Examiners, an application should be submitted in writing with supporting evidence to the Science and Engineering Faculty Officer for Appeals, Complaints and Discipline to **fseappealsandcomplaints@manchester.ac.uk** **not later than 20 working days** after the publication of the examination results. There is no provision for appeal against the academic judgement of the Examiners. An appeal may be made only on the grounds alleging:

1. That there exists or existed circumstances affecting the student's performance of which the Examiners had not been made aware when the decision was taken; or
2. That there was a material administrative error or procedural irregularity in the examination process; or
3. That there is evidence of prejudice or bias or of inadequate assessment on the part of one or more of the Examiners.

Academic Appeal is covered by Regulation XIX. Other student complaints are covered by Regulation XVIII. All Academic Appeal information can be found **here**.

If you have a student complaint, you should follow the Student Complaints procedure. All information for this can be found **here**.

10.13 Transcripts

Official transcripts should be requested from the Student Services Centre. There is a charge for this and students should note that it usually takes around 6-8 weeks. Unofficial transcripts can be requested from the Teaching and Learning Office by emailing **physics@manchester.ac.uk** with your student ID number.

11. Student ill-health and other matters affecting work and assessment

11.1 Student Ill-Health

- **It is a requirement of your registration with the University of Manchester that you register with a local medical general practitioner (GP).**
- A list of GP practices can be obtained from any University hall of residence, a local Pharmacy or via **NHS Direct**

In the following sections there will be a reference to a University **certification of student ill health form**. This is used whenever illness leads to absence of more than 7 days, or where it affects assessment, as described below. The form has three parts. The first part is completed by the student, the second part may be ignored, and the third part must be completed by a medical practitioner. The completed certificate should be handed in to the Student Support and Welfare Team at the earliest opportunity.

- The Manchester Local Medical Committee has agreed the use of the form by GPs, and copies are available at local surgeries. A GP may make a charge for completing the form.
- **All references to this form below require part III to be completed, signed and stamped by a medical practitioner;** however if necessary a medical certificate from a hospital doctor or non-local GP may be substituted for part III of the form. Please note that a hospital attendance slip alone is not sufficient.
- If you are found to have been deceitful or dishonest in providing a certification of student ill health form, you could be liable to disciplinary action under the **University's Conduct and Discipline of Students Regulation XVII.**

11.2 Emergency Illness

You should always consult your GP (or for emergencies the Accident and Emergency Department of a hospital) if you are severely ill, if an illness persists or if you are in any doubt about your health.

11.3 Illness and other problems affecting work, attendance and assessment

The following paragraphs explain what you should do if your illness affects your attendance at compulsory classes, lectures, lab or examinations or if you feel that your performance has been impaired by your illness. The same principles apply to other causes of absence.

Missing lab and lectures

If illness keeps you absent from the University for more than 7 days including weekends, you must consult a GP and obtain a certification of student ill health. You must also contact the Physics Student Support and Welfare Team as soon as possible.

Otherwise, if your condition is not sufficiently serious to cause you to seek medical help, then the University will not require you to supply a doctor's note. You **must** however contact the Student Support and Welfare Team as soon as possible and self-certify your illness by completing and signing the **Short Term Absence Form** to state you have been ill. This will come into effect if you miss lab and/or 3-7 days of lectures, or if you are able to attend the University but your illness is affecting your studies. Talk to the Physics Student Support and Welfare Team and Lab Tutor if relevant.

Extensions to deadline due to ill health

If, as a consequence of your illness or other problems, you wish to seek an extension to a deadline for submitting assessed coursework, you should consult the staff member responsible for the unit and the Physics Support and Welfare Team as soon as possible, and complete the **Extension form** **in advance of your deadline**. You will in addition need to submit a certification of student ill health form. Retroactive applications will only be accepted in exceptional circumstances.

Missing examinations and assessment or poor performance at examinations or in assessment due to ill health

If you are unwell and feel unable to attend the University to take a compulsory assessment or examination then you **must** seek advice by contacting the Teaching and Learning Office immediately, in person, through a friend or family member, by telephone or by email. **You must do this as soon as possible, and certainly no later than the day of your compulsory class, assessment or examination, so that all options can be considered.** If you do not do this then you will normally be considered to have been absent from the class without good reason, or to have taken the assessment or examination in which case you will be given a mark of zero.

In either case you **must** also hand in a Certification of Student Ill Health form on your return. If you leave this until later it will not normally be possible to take your illness into account when assessing your performance.

Missing examinations and assessment and poor performance at examination or in assessment due to ill health will be dealt with by the School's Mitigating Circumstances please see **Section 11.4 What are mitigating circumstances?**

Continuous ill health affecting assessment

You may be under occasional and ongoing medical attention which affects your studies. If so, you should obtain a letter from your GP which should be given to the Teaching and Learning Office before the end of January, May/June or August/September examination period, as appropriate, if you wish your condition to be taken into account as a mitigating circumstance. You can also email supporting documentation to **physics.support@manchester.ac.uk**

If your problems are chronic and/or ongoing and relate to an illness or disability, you should register with **The Disability Advice Support Services (DASS)**. Your problems will then be dealt with by reasonable adjustments to the teaching or assessment process, and not by the Mitigating Circumstances procedure. However in cases where the reasonable adjustments have not been put in place in time, or a change, worsening or flare-up of the condition has meant that the reasonable adjustments were not sufficient, you may apply for this to be taken into account as mitigating circumstances. You do not need to provide any additional supporting evidence. However, you must provide a detailed explanation of how your disability is currently affecting your studies and complete the online Mitigating Circumstances form. It is not sufficient to indicate only that you are registered with DASS. A Disability Advisor from DASS will liaise with the Mitigating Circumstances Committee that will consider your application.

If you need to apply for mitigating circumstances for an issue that is not directly related to your disability, or you have a disability but are not registered with DASS, you must apply in the same way as other students. See **Section 11.6 How do I apply for mitigating circumstances?**

Occasionally, illness or other circumstances mean that students cannot continue their studies without taking a break. This is dealt with in **Section 11.8 Interrupting and repeating study**

11.4 What are mitigating circumstances?

Mitigating Circumstances are problems, such as illness or misfortune, which adversely affect your performance in, or ability to complete, assessments. Crucially, such circumstances must be unpreventable and unforeseen.

Possible mitigating circumstances include:

- significant illness or injury,
- the death or critical/significant illness of a close family member/dependent,
- significant family crises or major financial problems leading to acute stress,
- absence for public service, e.g., jury service.

Circumstances that will ***NOT*** normally be regarded as grounds for mitigation include:

- holidays, moving house and events that were planned or could reasonably have been expected,
- assessments that are scheduled close together,
- misreading the timetable or misunderstanding the requirements for assessments,
- inadequate planning and time management,
- failure, loss or theft of a computer or printer that prevents submission of work on time (students should back up work regularly and not leave completion so late that they cannot find another computer or printer),
- consequences of paid employment (except in some special cases for part-time students),
- exam stress or panic attacks not diagnosed as illness or supported by medical evidence,
- disruption in an examination room during the course of an assessment which has not been recorded by the invigilators,
- extra-curricular activities.

Events may arise during pregnancy that may constitute mitigating circumstances, and these need to be judged on an individual basis.

If your problems are continuing, the panel will look for reassurance that you are able to manage them in the future.

11.5 Mitigating Circumstances Committee (MCC)

- The Mitigating Circumstances Committee (MCC) meets to rule on requests for mitigation. If the MCC accepts the case then the MCC proposes mitigation to the examination board. The examination board, meeting in June and September, makes the final decisions on mitigation.
- The MCC meets three times per year in February, June and September, a few days after the end of each of the three examination periods,
- Cases pertaining to each semester, or to the summer vacation, are considered by the next meeting of the MCC.
- Mitigating Circumstances relating to coursework are normally dealt with by the relevant course tutor and reported to the MCC to ensure consistency of practice.
- At times, decisions may have to be made outside of the MCC and such cases will be dealt with by the Director of Teaching & Learning, Chief Examiner and the relevant year examiner.

- Students will be contacted and informed of their Mitigating Circumstances outcome by the Teaching and Learning team within 10 working days from when the committee meets. Remember to check your University email account regularly. After the February meeting students will be informed if their case has been accepted, but any ensuing actions will not be confirmed till the examination board meets in June.
- The School of Physics and Astronomy will consider requests for mitigation for students on all programmes covered in this handbook, even when the course units affected are administered by another School.

11.6 How do I apply for mitigating circumstances?

The Mitigating Circumstances Form should be completed online by any student who experiences unpreventable or unforeseeable circumstances that could have a significant adverse effect on their academic performance either in progression to the following year or their final degree classification.

Your application must be supported by evidence. It is vitally important that you submit your application as early as possible, **BEFORE** the relevant deadline, otherwise your case may not be considered.

Mitigating Circumstances submission deadlines:

Semester one: Monday 28th January 2019 at 4pm

Semester two: Thursday 6th June 2019 at 4pm

Resits: Monday 2nd September 2019 at 4pm

ALL supporting evidence and documentation should be submitted via e-mail to **physics.support@manchester.ac.uk**, or handed in to the Teaching and Learning Office based on the First Floor of the Schuster building. All evidence will be treated in strictest confidence.

Examples of supporting evidence:

- A certification of student ill health form
- A signed and dated letter from a medical or health practitioner
- A signed and dated letter from a registered counsellor

Please note:

- Hospital attendance slips that do not include any diagnosis from a health practitioner are **NOT** acceptable.
- If your evidence is in a language other than English, it is your responsibility to include a certified translation.
- Disclosure to your Personal tutor or other staff member does not count as evidence.

What happens if I submit my mitigating circumstances late?

If you submit your mitigating circumstances late but before the Mitigating Circumstances Committee meet, they will require a compelling reason for the late submission.

Disclosure of mitigating circumstances after exam results are published: please refer to **Section 10.12 Academic Appeal**

For further information on the University and School Mitigating Circumstances procedures see:

- **Policy on Mitigating Circumstances**
- **Mitigating Circumstances Procedures**
- **A Basic Guide to Mitigating Circumstances**

Guidance is also available from the **Students' Union**.

11.7 Possible outcomes of the Mitigating Circumstances

It is extremely rare for a student to be excused a full year or given a degree on the basis of previous performance. In general the MCC will attempt to give students who have accepted mitigating circumstances opportunities to retake assessments where possible within University regulations, but this is usually not possible in the 3rd and 4th years. The options discussed below are always at the discretion of the MCC and should not be considered as guaranteed even once a given circumstance is accepted. Please note, in some cases, mitigating circumstances can be flagged for consideration in future years.

- **1st and 2nd years:** In cases where accepted circumstances are localized to a particular assessment then students will normally be allowed to take the resit exam for that particular course as a first attempt if it is preventing their progression. NB. There are no resits for lab and some other continuously assessed courses. If the student has demonstrated their ability to pass a course unit, but the MCC accepts that the circumstance has had a significant effect on their performance, one or more course units may be excluded from the year average. In more serious cases, affecting a full semester or the whole year, the MCC may allow any failed courses to be re-taken as a first attempt, and others compensated. In very serious cases the MCC may advise the student to interrupt their studies.

- **3rd and 4th years:** In cases where accepted circumstances are localized to particular assessments then MCC may exclude specific courses up to 45 credits. Students must identify those course units to which they want mitigation applied on the Mitigating Circumstances form. In this case the year average is computed over all non-excused course units. In more serious cases, affecting a full semester, or if it has affected the whole year, then the MCC will may choose to extend the boundary zone for degree classifications by up to no more than 2%. In very serious cases the MCC may advise a student to interrupt their studies.

11.8 Interrupting and repeating study

The expectation is that a degree course is taken over three or four consecutive years and breaks in study are exceptional. However for a variety of reasons, students may be given permission to interrupt and to repeat a period of study. Students should consult the **University Guidance on Interruptions**.

There is no automatic right to interrupt, and applications will be considered by the school Interruptions Committee during the year or the Mitigating Circumstances Committee after the June exams. Students will normally return from interruption to resume study in September or January at the start of the semester during which their problems appeared, taking all labs and courses as usual. All previous work and assessment from repeated semester(s) is set aside. Fees are not due while a student is not in attendance.

Students may a request an Interruption of studies if, during the semester, they encounter circumstances such as a serious illness that make it impossible to continue studying. Applications should be submitted to the Student Support and Welfare Team, and students who wish to explore this option should contact them in the first instance.

If students reach the end of the year but the Mitigating Circumstances Committee considers that a student's circumstances have affected their assessments too badly for direct progression to be advisable

or feasible, it may recommend interruption. (In first or second year, this may be decided after the resits.) If the circumstances affected only the exams, the student may be given the opportunity to suspend their studies and retake the relevant exams during the next academic year; during that year they will not be registered students and will not attend classes. This is *repeating without attendance*. If the circumstances affected most of a semester, or both semesters, the student will be given the opportunity to *repeat in attendance.* As discussed above, only very exceptionally will evidence of mitigating circumstances be considered after the assessments have taken place.

Where interruption or repetition is for medical reasons, you will be contacted by the Student Support and Welfare team before you are due to return to study to check that you are well enough to return to your studies. You will be required to send in a letter from your doctor confirming your fitness to study

Students should note that permission to interrupt or repeat will be given subject to the condition that the regulations on compensation, progression, award of degree etc. will be those applying to the cohort which they join, rather than those which applied when they entered the University.

A less common form of interruption is to take advantage of an opportunity, such as a placement or intern position, which would be likely to have a significant positive impact on a student's future employability or career prospects; this typically happens after passing one academic year, with the next academic year started twelve months late.

12. Progression and Degree Classification Regulations

To progress from one year to the next the 120 credits of course units must be successfully completed. In principle, this means that the assessment of each unit is passed at 40%. However up to 40 credits may be allowed with lower marks; this is termed compensation and the details vary by year as specified below. *In first and second years students may be required to resit failed units, and hence should ensure that they are free in the relevant period.*

Students who are borderline between classes of degree or borderline for progression to year 4 may be called for an interview (also known as a viva voce examination or viva) with the external examiners, see; see section **12.5 Consideration of candidates at borderlines**. Dates when students may be called for interview will be communicated well in advance. All students in years 3 and 4 should ensure that they will be free at this time, and that the Teaching and Learning office knows how to contact them in this period. You must check your University email address that week and ensure that all of your telephone contact details are up to date on the system.

12.1 Criteria for Progression on the BSc Programme in Years 1 and 2.

A student can progress to the subsequent year of a BSc programme if they have

- 30% or above in all units *and*
- 40% or above in laboratory work and other course units, to a total of at least 80 credits.

A student who does not pass at least 60 credits at 40% at the first attempt, including lab, will normally be withdrawn from the course.

A student who passes at least 60 credits at the first attempt but who does not meet the criteria above will be required to resit in August / September all course units with a mark <30%, and may be required to resit some or all course units with marks between 30% and 39%. This is described as referred assessment. Normally all failed (<40%) core course units will be referred.

A student who does not meet the criteria above after referral will normally be withdrawn from the course.

Progression on degree programmes combining Physics with another subject will require satisfactory performance in both subjects: normally each subject should be separately passed and approximately two-thirds of the course units of each subject should be passed. For students on the first year of the Maths and Physics programme, all Maths courses are non-compensatable. Students failing to satisfy these additional requirements may be required to switch to another programme.

Occasionally a student who has failed to obtain all of the credits for the year (after referral where available) may at the examiners' discretion be allowed to progress but required to take extra credits in the subsequent year. This will normally be limited to 10 credits, will not normally apply to core courses, and permission will only be granted when the remaining credits have been passed with not more than 10 credits having been compensated. The corresponding number of extra credits in the subsequent year must then be passed at 40%.

A student who does not complete a degree programme but has satisfied the criteria for progression to the second year is eligible for the award of a Certificate of Higher Education. One who has satisfied the criteria for progression to the third year is eligible for the award of a Diploma of Higher Education.

12.2 Criteria for Progression on the MPhys and MMath&Phys Programme in Years 1, 2 and 3

For the **first year**, the criteria are the same as for the BSc programme.

For the **second year**, for all MPhys and MMath&Phys programmes not involving a year abroad, in addition to the BSc progression criteria, the year average mark obtained at the first attempt must be 55% or above. Students who fail to obtain this mark will usually register for the appropriate BSc programme in their third year.

Students whose year average marks at first attempt are borderline (53% - 55%) may be permitted to register provisionally for MPhys with a review based on their Semester 5 January exam results. As a guide an average mark of 55% on exams will be expected. If this is not achieved, the student's registration will be changed to BSc.

Physics with Study in Europe students must achieve an average mark in all assessments in semester 3 of at least 55%, and a second year average at first attempt of 60% or above. Students who do not achieve 55% in S3 or 60% for the year will have their registration changed from Physics with Study in Europe to Physics. They may make the case for remaining on the Study in Europe programme if their S3 mark is over 53%, if their year mark is over 58%, or if there are mitigating circumstances which may have affected their marks.

Other students who intend to spend their third year abroad will have been given specific targets which are generally higher than these criteria in order to be confirmed on the study abroad year, but as an absolute minimum they must meet the MPhys progression criteria. Failure to do so, or failure to meet the specific targets for their placement, will result in withdrawal of approval for study abroad, and you should bear in mind this possibility when making travel, accommodation or other arrangements.

All students on programmes requiring study abroad in the third year may find that there is a conflict between the timing of the second-year resits exams and the starting date of the third year. In this case students may need to change to another programme which allows them to stay in Manchester, or to interrupt for a year.

For the **third year**, the criteria are as follows. A student can progress to the final year of an MPhys programme if they have;

- a year average mark of 50% or above *and*
- an overall mark of 50% or above, *and*
- 40% or above in laboratory work and other course units, totalling at least 80 credits.

The overall mark is a weighted average of the first three year marks; the weights are given in the first line of the **Table: Weightings 1** below.

Students who have spent their third year in Manchester who fail to meet the criteria for progression to the fourth year will be considered as follows:

- If they are borderline then they will be subject to a mark review, which may include an interview, as set out in stages 3 and 4 of section **12.5 Consideration of candidates at borderlines**. The outcome may be permission to progress, or the award of a lower second or third class BSc degree;
- otherwise they will be considered as a BSc candidate.

To continue on the MMath&Phys degree, Mathematics and Physics students must in addition obtain a year average mark in each subject of at least 45%. Students on other programmes combining Physics with another subject must similarly demonstrate appropriate performance in both subjects.

Students spending the third year abroad are expected to perform satisfactorily on the courses they take there: broadly, the examiners are looking for work of a similar standard as would be required of students remaining in Manchester (which, in their case, is a minimum 50% year average mark). Students who fail to achieve at around this level will return as candidates for the BSc and will follow the usual third year BSc Physics programme.

12.3 Referrals and Resit Examinations

For students who have referred assessment, resit examinations for course units in either semester take place in August and September. There is a re-examination fee.

If a student fails a continuously assessed unit, such as laboratory work, it may be possible to pass the unit by submitting supplementary work; the School reserves the right to charge for the cost incurred. However, if a substantial part of the work has not been successfully completed the student will not be allowed to proceed.

Progression will be subject to meeting the appropriate criteria for the programme after the marks for courses failed in January/June have been replaced by the resit marks. Resit marks are capped at 30%, except where the mark for the first attempt is above 30%. It is the capped resit marks (or the original mark if above 30%) that contribute to the year average mark and therefore to the overall mark for degree classification purposes.

There are no resits for third and fourth year examinations, but there is also no minimum compensatable mark.

Compensated marks will be shown on the transcripts as the actual mark, e.g. "38C". Capped resit marks will be shown as "30R".

12.4 Criteria for Degree Classification

For each year of study, a mark for the year is calculated as a weighted average of all assessments, including zero-credit-rated units. See **Section 7.2 Mathematics and Physics [BSc, MMath&Phys]** for further comments on the calculation of the year mark.

In calculating the overall mark for degree classification, the marks for each year of study are combined in a weighted average as given below.

Table: Weightings 1

BSc and MPhys Programmes	Year 1	Year 2	Year 3	Year 4
All three-year programmes	10%	30%	60%	-
All four-year programmes (**except** year 3 abroad)	6%	19%	37.5%	37.5%
All four-year programmes (**with** year 3 abroad)	8%	23%	23%	46%

Students who have been admitted directly to the second or third year of a programme will not have year average marks for all years, and hence the table above for combining the year average marks is modified. Those years which they have done contribute in the same proportion as for other students on the same programme, but the absolute values of the weights are increased to total 100%. For a student admitted to the second year of a BSc programme, for instance, the 2nd and 3rd years will contribute 33.3% and 66.7% respectively.

The classification criteria are normally the following:

- **Ordinary degree**: A satisfactory work and attendance record, a knowledge of basic physics, and competence in using experimental equipment.
- **Third class honours degree**: The ability to apply knowledge of basic physics to solve straightforward problems and to work effectively in the laboratory.
- **Lower second class honours degree**: An extensive knowledge of physics and the ability to apply this knowledge to solve problems involving several steps of analysis; the ability to tackle laboratory problems with confidence and to seek reliable and accurate solutions.
- **Upper second class honours degree**: An extensive knowledge and sound understanding of physics and the ability to apply this knowledge and understanding to new and unfamiliar problems; the ability to develop and apply strategies for tackling laboratory problems which lead to reliable and accurate solutions.
- **First class honours degree**: An extensive knowledge and deep understanding of physics, and the ability to solve theoretical and laboratory problems that require insight and initiative.

The relation between the degree classification and the overall mark is normally as indicated in the following table; credit requirements and the treatment of borderline candidates are detailed below.

first class honours	70.0-100%
upper second class honours	60.0-69.9%
lower second class honours	50.0-59.9%
third class honours	40.0-49.9%

An MPhys or MMath&Phys candidate will be awarded a first, upper or lower second class degree if they have

- an overall mark in the appropriate range (see above) *and*
- 40% or above in final year course units totalling at least 80 credits, including project work.

Third class master's degrees are not awarded. A candidate who does not satisfy the criteria for the award of a second class MPhys or MMath&Phys will be awarded a BSc on the basis of their marks in the first three years.

A BSc candidate will be awarded a first, upper or lower second class BSc degree if they have

- an overall mark in the appropriate range (see above) *and*
- 40% or above in individual final year course units totalling at least 80 credits, including laboratory work and BSc dissertation.

A BSc candidate will be awarded a third class degree if they have

- an overall mark in the range 40.0-49.9% *and*
- 40% or above in individual final year course units totalling at least 60 credits, including laboratory work and BSc dissertation.

A BSc candidate will be awarded an ordinary degree if they have failed to satisfy the criteria above, but have 40% or above in third year course units totalling at least 60 credits. The ordinary degree is only awarded with the titles "Physics", and "Mathematics and Physics".

Any honours degree candidate who has 40% or above in final year course units totalling less than 80 credits, but at least 60 credits (including laboratory, dissertation or project work as relevant), will be awarded a class of degree one lower than indicated by their overall mark (e.g. 60.0-69.9%, but with only 60 or 70 credits passed at 40% in final year, is awarded a lower second).

The requirement to pass certain units, e.g. Laboratory work, does not apply to those students whose programme does not require these units to be taken.

In order to determine if the requirement of 40% or above in laboratory work/BSc dissertation/MPhys Project work has been met in order to progress or graduate, the mark before any late penalty is applied will be used. However, the late penalty mark will be applied in calculating the year average and in counting in the number of credits passed in order to progress or graduate.

12.5 Consideration of candidates at borderlines

Students who narrowly miss the criteria for a particular degree classification are said to be at a borderline. This may be because they have an overall mark in a boundary zone, or because they have insufficient credits passed at 40%. The "boundary zone" is up to 2% below the lower bound for each degree class listed above, except that the third class boundary zone is up to 3% below (i.e. 37.0% -39.9%).

Please note: non-final-year 2018-2019 students should note that this process is currently under review and may change from 2019-2020.

The examiners consider borderline candidates with a view to awarding the next higher class of degree in up to four stages:

Stage 1 (algorithmic mark distribution):

If a student has gained marks at or above the level required in units totalling

- 80 credits in year 3 (BSc classification, or progression to year 4) or
- 75 credits in year 4 (MPhys or MMath&Phys classification) then they will be awarded that class. If not, proceed to stage 2.

Stage 2 (criterion-based mark review)

If they have obtained

- 70 credits for the year at or above the level required, *and*
- marks for final year project work, or dissertation, at or above the level required, *and*
- a year average mark which is higher than the overall mark, then the external examiners have agreed to recommended the award of that class. If not, proceed to stage 3.

Stage 3 (Classification review of assessed work)

The external examiners will review exam scripts, project reports and other assessed work. If they find evidence of the student's performance according to the relevant class descriptor given in **Section 12.4 Criteria for Degree Classification** they may recommend to the exam board the award of that class. If not, proceed to stage 4.

Stage 4 (*viva voce* examination)

The external examiners will interview the student, and if they find evidence of the student's performance according to the relevant class descriptor given in **Section 12.4 Criteria for Degree Classification**, they may recommend to the exam board the award of that class.

A similar procedure will be applied to students who narrowly fail to satisfy the criteria for progression to the fourth year of MPhys or MMath&Phys. Therefore, as noted above, **all** third and fourth year students may be called for an interview. Failure to attend when invited for interview is likely to result in a recommendation for the lower class of degree, or for non-progression, as appropriate.

13. School of Physics and Astronomy Scholarships and Prizes

Every year, the School of Physics and Astronomy makes a number of awards to students, subject to the availability of funds and of suitable recipients. The details and regulations of scholarships and prizes are as follows.

First Year

Heginbottom Exhibition

An award is given to the best performing student in annual examinations (including laboratory work) in the first year.

John Wiley Book Prize

The runner-up in the Heginbottom Exhibition will receive John Wiley books. This prize is administered by Prof. F. Loebinger.

Don Butler Prize

An award is given for the best performing student in 1st year laboratory.

Second Year

Hatfield Scolarship

An award is given to the best performing student at the end of second year, tenable in the third year of the degree.

Moseley Physics Prize

An award is made to the runner-up in the Hatfield Prize. The prize is normally awarded to a second year student.

Richard Davis Prize

An award is given for the best performing student in 2nd year laboratory.

Vacation Essay Prize

An award is made to the writer of the best vacation essay.

Walter Grattidge Prize

An award is made to the best performing student in the General Physics exam.

Third Year

Hatfield-Heginbottom Scholarship

An award is given to the best performing student in third year who is proceeding to MPhys.

Walter Grattidge Prize

An award is made to the best performing student in the General Physics exam.

Finals (BSc & MPhys)

Samuel Bright Research Scholarship in Physical Science

An award is given to an MPhys Final student who is going on to do a Ph.D., not necessarily in Manchester.

Selina Bright Research Scholarship in Physical Science

An award is given to a BSc Final student who is going on to do a Ph.D., not necessarily in Manchester.

Platt Prize:

An award is given to both a BSc and an MPhys graduate for experimental work carried out in the final year of any undergraduate degree programme.

Franz Mandl Prize:

An award is given to both a BSc and an MPhys graduate for theoretical work carried out in the final year of any undergraduate degree programme.

Tessella Prize for Software

An award is given for the best use of software in an MPhys project.

University Outstanding Academic Achievement Awards

The examiners will consider nominations for these awards from amongst the students graduating with the highest overall marks.

Any Year

The Tony Phillips Prize

An award is given to the undergraduate student who is deemed to have improved the most.

The Alison Uttley Prize

An award is given to the student who has contributed most to the life and work of the school.

The Alan Greenwood Prize

An award is given to the student who has contributed most to promoting and enhancing opportunities for equality and diversity within the school.

APPENDIX 1: Competencies required for undergraduates completing a degree programme in the School of Physics and Astronomy

This section describes how competencies are defined and assessed in the School.

"The Purposes of a Manchester Undergraduate Education (The Manchester Matrix)" sets out eight areas which students undertaking undergraduate education at the University of Manchester are expected to achieve by the end of their study.

The graduate attributes are a set of core competencies which students are expected to achieve through completion of any University of Manchester programme.

Item 2 in the Manchester Matrix is expanded with specific attributes for degree programmes in the School of Physics and Astronomy. These attributes (incorporating the general outcomes for the degree programmes, the lectures, tutorials, laboratory work and workshops, and the intended learning outcomes for individual course units) are described in this Undergraduate Handbook in **APPENDIX 2: Aims and Objectives for Teaching and Learning**

These attributes are reviewed by the Institute of Physics every five years. All programmes are accredited by the Institute of Physics. The skills and achievements of graduates of accredited degrees are set out in **The Physics Degree** which includes the *Core of Physics*, the key concepts which must be covered in all accredited programmes.

Moreover, the programmes comply with the **Quality Assurance Agency for Higher Education (QAA) subject benchmark for Physics, Astronomy and Astrophysics**

When assessing whether a student has achieved a competency, various methods are used. The method chosen for each course unit is described in the Undergraduate Handbook and has been deemed appropriate to assess the learning outcomes by the School Teaching & Learning Committee.

Lecture based courses are normally assessed in unseen and time-constrained examinations. The unseen element ensures that the material required for all the learning outcomes has been absorbed and understood by an individual student. The time-constrained element tests the student's capacity to organise work, as well as to think and communicate under pressure.

The School recognises that undue pressure can lead to stress. To quote the **Health and Safety Executive**: "There is a difference between pressure and stress. Pressure can be positive and a motivating factor, and is often essential in a job. It can help us achieve our goals and perform better. Stress occurs when this pressure becomes excessive. Stress is a natural reaction to too much pressure."

Consequently, examinations are carefully written and checked internally and externally, to ensure that the relevant learning outcomes of a course unit can be tested in the appropriate time period.

The knowledge and understanding of basic physics formulae appropriate to each of our course units is also a competency. Understanding of physics at university level and beyond is inextricably intertwined with mathematics – a phrase that is commonly used is that mathematics is the language of physics. The understanding, derivation and application of these formulae in an examination, demonstrates a student's underpinning knowledge of physics.

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APPENDIX 2: Aims and Objectives for Teaching and Learning

All undergraduate programmes in physics aim to

1. Offer an opportunity to study Physics within an internationally-leading research environment.

2. Provide students with a sound base of knowledge and understanding of basic physics principles, to expose them to the applications of these principles in a broad range of areas, and to allow them to study some of these in depth.

3. Provide the opportunity for students to study a specialised area of physics such as astrophysics or theoretical physics to an advanced level, and to obtain a degree whose title reflects this.

4. Give students the possibility of combining the acquisition of a sound base of physics with the study of a foreign language, and offer the opportunity to pursue a part of their studies in another European country or in North America or Singapore.

5. Provide students with a training in the mathematical techniques which underpin physics, and to offer them the opportunity to develop related skills and knowledge to a high level.

6. Provide students with comprehensive training in laboratory techniques, the skills of investigation planning, and handling of experimental apparatus, data analysis and interpretation, and the communication of results.

7. Foster students' development of transferable and personal skills, including those of problem-solving, analysis, independent learning, team-working, IT and communication, which will be essential to their future careers.

8. Provide a flexible structure within which students' changing interests and aspirations can be accommodated.

9. Provide students with a friendly and supportive environment in which to develop intellectually and personally.

10. Equip students for employment in a broad range of disciplines, particularly those which value numerate graduates who can apply their knowledge and problem-solving skills to real-world situations.

11. The Masters level programmes aim to provide students with knowledge and skills which will equip them to start a doctorate, and to expose them to a sufficient range of topics that they can make a well-informed choice of subject area.

12. The Masters level programmes also aim to further equip students for professional employment, in particular by developing their analytical skills within and beyond the boundaries of Physics and by equipping them to make sound decisions in the absence of complete information.

Outcomes for all undergraduate programmes in physics

Knowledge and Understanding – Graduates should be able to:

1. Demonstrate a knowledge and understanding of fundamental physical laws and principles, in particular in the areas of classical and quantum mechanics, electromagnetism, statistical physics, wave phenomena, thermodynamics and properties of matter.

2. Apply these principles to diverse areas of physics, including a number of the following: astrophysics, atomic physics, laser physics, particle and nuclear physics, condensed matter physics and materials, plasmas and fluids and biomedical physics. The range of applications encountered will be programme dependent, but all students will encounter several.

In addition students completing a Masters programme should be able to:

3. Demonstrate achievement of the learning outcomes of the corresponding bachelors' programme at a higher level than in their third year deriving from the study of advanced topics, many at the forefront of the discipline.

Intellectual skills – Graduates should be able to:

1. Formulate and solve problems in physics, identifying the relevant physical principles and making approximations necessary to obtain solutions; use special cases and order-of-magnitude estimations to guide their thinking and make assumptions clear in the presentation of their solution.

2. Use mathematics to describe the physical world and show an understanding of mathematical modelling of physical phenomena; use appropriate mathematical tools in physics problems.

3. Carry out a substantial open-ended investigation; analyse critically the results of an investigation, with particular reference to the significance of the results and how they compare with theoretical prediction.

In addition students completing a Masters programme should be able to:

4. Apply fundamental physical laws and principles to diverse areas of physics including some at the forefront of the discipline.
5. Apply their theoretical and practical skills to the understanding and/or investigation of subjects at the forefront of knowledge.
6. Use a wide variety of source material including primary sources.

Practical skills – Graduates should be able to:

1. Work safely in a laboratory, identifying hazards and operating apparatus to avoid risk to themselves and others.
2. Demonstrate technical competence in adjustment, calibration and use of experimental apparatus.
3. Communicate the results of an experiment in formal presentations, both oral and written.

In addition, students completing a Masters programme should be able to:

4. Plan and carry out an investigation under supervision; analyse the results critically making appropriate reference to prior relevant original research.

Transferable skills enhanced by the degree programmes include the ability to:

1. Present data graphically and use appropriate IT and programming tools to analyse data at a level appropriate to their degree.

2. Communicate scientific information orally and in writing, at a level appropriate to their degree demonstrating the awareness of the requirements of different types of published output.

3. Organise their own learning and use appropriate learning resources; work both independently and as part of a team.

In addition, students completing a Masters programme should be able to:

4. Demonstrate enhanced personal skills from studying in another country.

In addition, students studying Physics with Study in Europe should be able to:

5. Demonstrate the high level of personal organisation and motivation needed to study in Europe.

In addition, students completing a Masters programme should be able to:

6. Work independently in both lecture-based courses and project work.

Aims and Learning Outcomes distinctive to particular degree programmes

1. Graduates in *Physics* will have demonstrated:
    - Knowledge and skills which are additional to those met in core physics. By selecting options, they may have studied particular topics in theoretical and experimental physics in more depth, taken courses in astrophysics, acquired extra skills in computing, and/or broadened their knowledge in applied science, mathematics, biological physics, genetics, economics, modern languages, the history and philosophy of science, business and management or other subjects.

    Graduates in *Physics with Astrophysics* will have:

    - Demonstrated detailed knowledge of astronomical phenomena and be able to explain the physical principles underlying these phenomena.
    - Appreciated principal issues in observational astronomy and carry out observations and analysis of astronomical data.

    Graduates in *Physics with Theoretical Physics* will have:

    - Demonstrated understanding of the role of mathematics in physics, both as a tool and at a deeper level as in, for instance, symmetry principles.
    - Used quantum mechanics in a variety of applications.
    - Used mathematical models and techniques at a higher level than is expected of physics students; using numerical as well as analytical techniques.

Graduates in *Physics with Study in Europe* will have:

- Demonstrated an appreciation of cultural differences in the approach to physics as a mathematical and practical subject.
- Shown that they can communicate fluently in a foreign language, in particular on scientific topics.

2. The *Physics with Philosophy* programme aims to:
   - Develop the ability to assimilate complex philosophical issues and present a clear, reasoned argument.
   - Develop an understanding of the mechanisms of acquiring and using knowledge and logic.
   - Prepare students for further study and research in physics and philosophy and for a wide range of career opportunities in industry, commerce and education.

3. The *Mathematics and Physics* programme aims to:
   - Offer an opportunity to study Mathematics and Physics within an internationally leading research environment.
   - Give students a grounding in the core ideas of mathematics, including the concept of rigorous argument and formal proof, and an appreciation of the power and generality of abstract formulation and the analytic method.
   - Provide an awareness of the broad range of applications that can be modelled mathematically and knowledge of the analytic and numerical techniques that can be used to solve the attendant problems.
   - Give students experience of advanced mathematical methods, ideas and thinking.
   - The Masters level programme also aims to further equip students for professional employment, in particular by developing their analytic skills within and beyond the boundaries of Mathematics and Physics.

Aims and Learning Outcomes of Lectures, Tutorials and Workshops

All the degree programmes have three main teaching and learning elements: lectures, tutorials and laboratory work. These are supplemented by self-motivated study, essay writing, computer-aided learning, project work, workshops and example classes.

The aims and objectives of lectures, tutorials, workshops and laboratory overlap, support and complement each other and contribute to achieving the aims and objectives of the degree programmes.

Lectures

The aims of lectures are:

- To develop understanding of a coherent body of knowledge of physics and mathematics.
- To develop the capability for logical analysis of complex phenomena.
- To develop the capability for independent learning from books and other sources of knowledge.

The following objectives are specific student learning experiences and achievements which go towards meeting the aims listed above:

1. To identify key physical concepts and to appreciate how they account for phenomena
2. To follow the essential steps in mathematical descriptions of physical phenomena
3. To evaluate, record and summarise material presented in lectures for use as a basis for further study
4. To seek understanding of material presented in lectures by:
    a. Asking questions of oneself, lecturers, tutors and other students
    b. Consulting books and other sources
    c. Solving qualitative and quantitative problems
    d. Doing laboratory experiments

Tutorials

The aims of tutorials are:

- To promote effective learning by providing feedback and guidance
- To enhance understanding of physics and mathematics
- To develop problem solving skills
- To develop skills in communication

The following objectives are specific student learning experiences and achievements which go towards meeting the aims listed above:

1. To consolidate understanding of material presented in lectures by:
    a. Asking questions
    b. Explaining concepts to tutors and to other students
    c. Solving problems and having them marked by tutors
    d. Obtaining feedback on their current level of understanding

2. To extend and deepen knowledge of physics by:
    a. Combining ideas and knowledge from different parts of the course
    b. Solving general problems in physics
    c. Discussing topics in advanced physics

3. To improve communication skills by:
    a. Discussion
    b. Asking and answering questions
    c. Writing essays
    d. Giving talks

Workshops

The aims of workshops are:

- To promote effective independent learning
- To provide an environment where students can work on problems and feedback and guidance can be sought if needed
- To develop the ability to express physics problems in mathematical language
- To develop problem solving skills
- To develop the ability to work in a group

The following objectives are specific student learning experiences and achievements which go towards meeting the aims listed above.

1. To analyse and apply material from lectures by:

   (a) solving problems individually

   (b) solving problems in groups

2. To meet new material which is best learned by solving problems

3. To consolidate understanding of material presented in lectures and workshops by:

   (a) asking questions (of other students and demonstrators)

   (b) explaining methods of solution to other students

   (c) obtaining feedback on their understanding in discussion with demonstrators (and other students).

Learning outcomes for Laboratory

It is expected that successful students will be able to:

	Year 1	Year 2	Year 3	Year 4
Safety Awareness	Use apparatus safely.	Identify hazards associated with an experiment to minimise risks.	Identify hazards associated with apparatus developed by the student him/herself, and undertake a risk assessment.	Undertake a risk assessment.
Investigative/Problem Solving Skills (i) Conduct and Initiative (planning, preparation, initiative)	Follow guidance on how to conduct experiments as explained in laboratory scripts and by laboratory demonstrators.	Demonstrate ability to think more widely than a given laboratory script, e.g., design an extension to an experiment in consultation with a demonstrator.	Develop and extend prescribed experimental procedures.	Develop and plan project in discussion with supervisor using original source material as a guide.
(ii) Technical Expertise	Use competently and safely a range of laboratory equipment.	Demonstrate technical competence in adjustment, calibration and use of experimental apparatus.	Be able to handle sophisticated apparatus with confidence.	Design and implement the steps necessary to undertake a project, i.e. acquisition and implementation of equipment, selection of appropriate theoretical tools and techniques, use of research level software and programming skills.
(iii) Recording and managing data	Keep detailed records of investigations in a laboratory notebook.	Keep full and careful records of all measurements and analysis in a laboratory notebook.	Keep professional quality records of laboratory work. Use computer aided data acquisition systems as appropriate.	Keep professional quality records of laboratory work. Use computer aided data acquisition systems and analysis methods as appropriate.

	Year 1	Year 2	Year 3	Year 4
Analytical skills (i) Techniques	Analyse the results of an experiment, describing the results numerically and graphically.	Critically evaluate the results of an experiment.	Critically evaluate the results of an experiment, assess the significance of the experimental results compared to expected outcomes and draw valid conclusions.	Critically evaluate the results and analysis of an experiment, choose experimental techniques which improve the outcome.
ii) Evaluation of errors	Identify the major sources of errors and estimate the effects on the overall results of an experiment.	Describe the sources of random and systematic error calculating their effects on the results	Describe the sources of random and systematic error, calculate their effects on the results and evaluate ways of reducing the dominant error.	Fully understand all sources of random and systematic error minimise their effect and calculate the final errors on all results.
Physics knowledge	Link the experimental findings to underlying physics acquired in lecture courses and elsewhere.	Make connections between fundamental principles and laws from across courses to explain experimental findings.	Link the experimental findings to underlying physics in lecture courses, textbooks and scientific journals.	Describe experimental findings with reference to research papers and a thorough exposition of the fundamental laws and principles underlying the experiment.
Communication skills (i) Oral presentation	Describe experiments clearly and concisely in a short, informal interview.	Describe experiments clearly and concisely in informal verbal presentations, defending procedures and analysis.	Describe an experiment in a formal presentation using visual aids, defending procedures, results and interpretation. .	Discuss a project in the light of research developments as part of a question and answer session following a presentation in a formal interview.
(ii) Written Presentation	Describe experiments clearly and concisely in a formal written report using a 'template' that defines the Department's preferred style.	Describe experiments clearly and concisely in a formal written report using a 'template' that defines the Department's preferred style.	Describe experiments in the style of a scientific paper and/ or in the form of a conference report.	Write a report to the standards of a scientific paper suitable for peer review including significant reference to primary sources

APPENDIX 3: Instances of Feedback

Please note; for all continuous assessment, students should expect feedback on their work within a **15 working day** timeframe as noted in the **Policy on Feedback** to Undergraduate and Postgraduate Taught Students.

Feedback - Instances of feedback by year/semester: (This is a minimum)

YEAR	Semester	Marked tutorial work	Lab Reports	On-line tests	Essays and other written work	Other	Total
1 Masters/BSc	1	10x4[1]	2	1	1[2]	4[3]	**48**
1 Masters/BSc	2	10x4[1]	2	0	1[4]	4[3]	**47**
2 Masters/BSc	3	10x4[1]	2	0	0	2[3]	**44**
2 Masters/BSc	4	10x4[1]	2	0	1[5]	2[3]	**45**
3 BSc	5	2x10[6]	2	0	1[7]	2[3]	**25**
3 BSc	6	2x10[6]	2	0	1[7]	2[3]	**25**
3 Masters	5	2x10[6]	2	0	1[8]	2[3]	**25**
3 Masters	6	2x10[6]	2	0	1[8]	2[3]	**25**
4 Maters Only	7 & 8	8X3[8] Examples Classes	0	0	2[9] Project report	0	**2**

Notes

[1] 4 X core modules where feedback is offered to students on example sheets at tutorials on a weekly basis (additional core depending on programme stream)

[2] Special topics, group work which is peer assessed.

[3] Lab experiments with oral and grade descriptor feedback to students by the demonstrators

[4] First vacation essay (written over the summer vacation)

[5] Second vacation essay (written over the summer vacation)

[6] 2 X Example classes each week to cover core courses where feedback is offered to students

[7] BSc Dissertation

[8] Staff will set students problem sheets for 4th year units and provide feedback. This would typically be 3 problem sheets for each unit depending on the units selected.

[9] MPhys Project