Advising and module choices for entrants to Physics and Astronomy in September 2024

(August 2024)

Plans and disclaimer

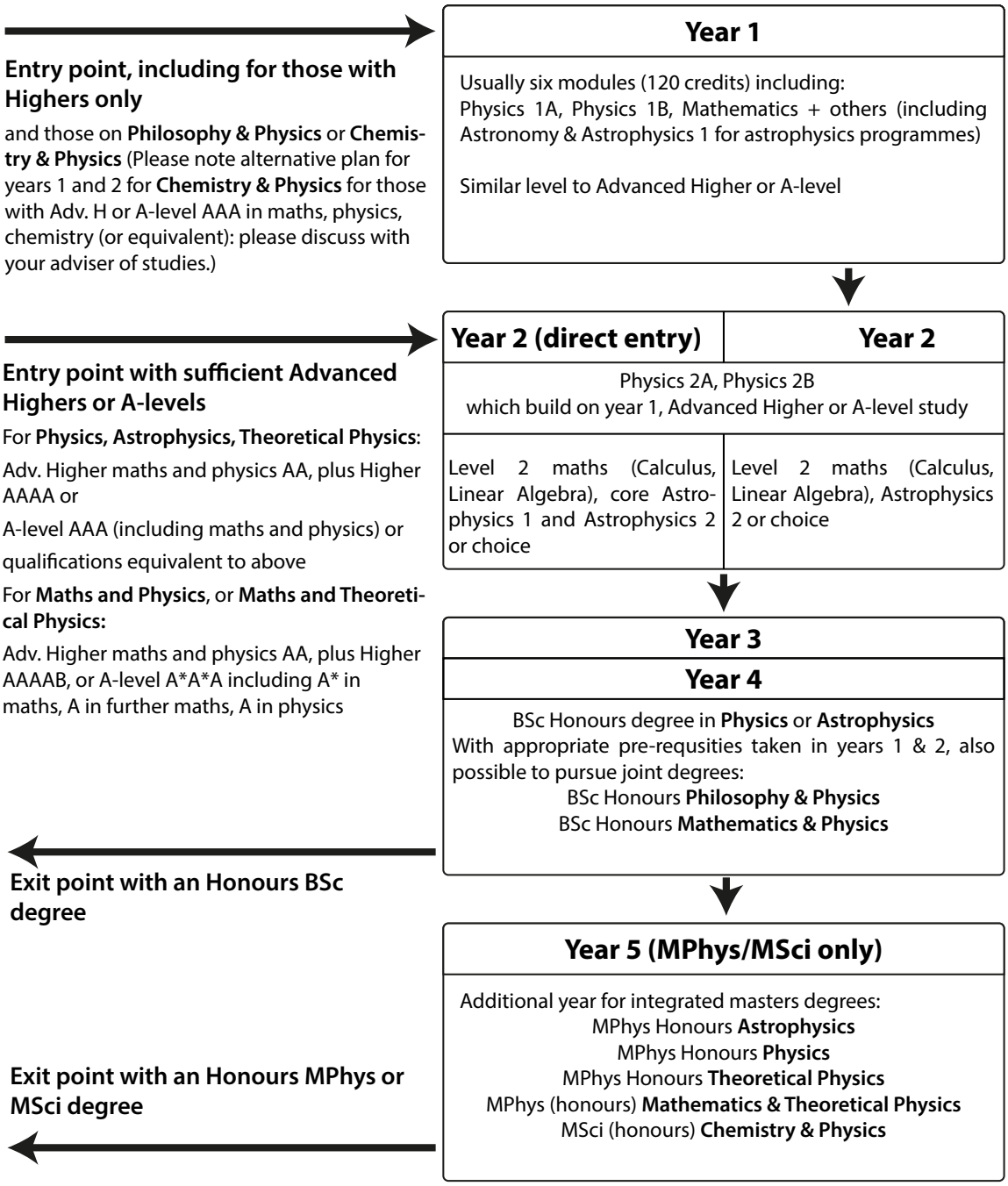
At the time of writing (late August 2024) we believe that what is written in this document is correct. The statements in programme requirements, the module catalogue, and University regulations take precedence over anything in this document.

Degree programmes

The undergraduate degree programmes involving our School are

- BSc (Honours) Astrophysics
- BSc (Honours) Physics
- BSc (Honours) Physics and Philosophy
- BSc (Honours) Physics and Mathematics
- Integrated Masters MPhys (Honours) Astrophysics
- Integrated Masters MPhys (Honours) Physics
- Integrated Masters MPhys (Honours) Theoretical Physics
- Integrated Masters MPhys (Honours) Theoretical Physics and Mathematics
- Integrated Masters MSci (Honours) Physics and Chemistry

Official statements of what are required at each level of study for each programme may be found in the University's Programme requirements.



The diagram above provides a brief explanation of the five years of our degree programmes. Years one and two are often referred to as 'pre-honours' or 'sub-honours' years, and years three, four and where five (where applicable), are often referred to as the 'Honours' years.

Those on joint degree programmes may have additional requirements for the other subject.

Entry routes

We have two main entry routes to our programmes:

- Traditional first year entry
- Direct entry to second year

First year entry

The first year entry route is the standard across the University, and is the entry point for those joining us straight from Highers. It can lead to a BSc honours degree in physics or astronomy in four years, or an MPhys or MSci honours degree in five.

This route allows maximum flexibility, as students can choose from several subjects to study alongside physics and mathematics in first year, and depending on module choices can progress from a successful first year towards a number of different degree options. Some of our joint degrees permit entry only by this traditional route, due to the necessary breadth of material to be covered.

The breadth of the traditional first year is also appreciated by students who know that they wish to take physics/astronomy to degree level, but want to pick up some university-level education in other subjects on the way through.

Direct entry to second year

This accelerated entry route is available for entrants with degree intentions of

- BSc or MPhys Astrohysics
- BSc or MPhys Physics
- MPhys Theoretical Physics,

and, subject to additional conditions,

- BSc Physics and Mathematics
- MPhys Theoretical Physics and Mathematics.

It allows well qualified entrants to bypass some or all first year study, and thus reduces the required time for a degree by one year.

There is some reduction in flexibility of final choice of degree, but there can still be options at the end of the entry year for degree programmes amongst physics, theoretical physics, joint degrees with mathematics, and where appropriate astronomy. In recent years around one third of our entrants have taken this accelerated route.

If your intended programme allows direct entry, and you have the required qualifications, and you're pretty sure that you don't want the additional flexibility that first year entry can provide, then direct entry is an option well worth considering.

For **Physics**, **Astrophysics** and **Theoretical Physics** programmes, direct entry to second level currently requires

- AAA in A-levels, with A in both Mathematics and Physics, or
- AA in Advanced Higher in Mathematics and Physics, and AAAA in Highers, or
- IB with at least 38 points including Physics and Mathematics (Analysis and Approaches) at HL6 or above, or
- qualifications equivalent to the above.

For **Physics and Mathematics** and **Theoretical Physics and Mathematics** programmes, direct entry to second level currently requires

- A*A*A in A-levels, with A* in Maths, A in Further Maths, A in Physics.
- AA in Advanced Higher in Mathematics and Physics, and AAAAB in Highers, or
- IB with at least 39 points including Physics and Mathematics (Analysis and Approaches) (and one other) at HL6 or above, or
- qualifications equivalent to the above.

We strongly recommend that those with A-levels taking direct entry to second level should have included at least one mechanics module in their mathematics A-level.

A-level qualified entrants starting one of our joint degrees with Mathematics require A*A*A, with A* in Mathematics and A in Further Mathematics to take second year entry. It is not possible to take second year entry to our joint degrees with Chemistry or Philosophy.

Accelerated entry students for degrees within the School must have Advanced Higher or A-level qualifications in Physics and Maths at grade A, or equivalent. Those with a degree intention of Mathematics and Physics or Mathematics and Theoretical Physics and who are entering with A-level qualifications need an A* in Mathematics, and an A in Further Mathematics. If you have the necessary qualifications, are sure that you wish to do a degree within the School, or joint with Mathematics, we suggest that you give this route serious consideration.

First year entry: module choices

Students will take 120 credits of modules in first year, usually in the form of three 20-credit modules each semester.

Students entering by this route will normally take PH1011 Physics 1A in first semester, and PH1012 Physics 1B in second semester. They will also take MT1001 Introductory Mathematics in first semester and MT1002 Mathematics in second semester, unless they have the qualifications needed to bypass MT1001, in which case they can take MT1002 in either semester.

Those considering a degree in astrophysics should also take AS1001 Astrophysics One, which is in first semester. All the above are 20 credit modules.

The remaining credits are made up of modules chosen by the student depending on their interests, or as required for the other subject of a joint degree. Students may choose modules from across the University, subject to timetable constraints and prior learning. Advisers of

studies can suggest options and discuss things to consider, but aren't able to suggest which of any "choice" modules are "best" for you to do, as this depends so much on your interests and longer term plans.

Two standard routes are given in the tables below. All the named modules shown are 20 credits each.

Route one, including MT1001 Introductory Mathematics:

Semester 1	***Semester 2***
PH1011 Physics 1A	PH1012 Physics 1B
MT1001 Introductory Mathematics	MT1002 Mathematics
Another module, for example AS1001 Astronomy & Astrophysics 1	Another module

Route two, bypassing MT1001 Introductory Mathematics:

Semester 1	***Semester 2***
PH1011 Physics 1A	PH1012 Physics 1B
MT1002 Mathematics	Another module
Another module, for example AS1001 Astronomy & Astrophysics 1	Another module

If AS1001 Astronomy and Astrophysics is chosen, then successful completion of both these schemes could lead to progression to the second year of a physics, astrophysics, theoretical physics, or mathematics degree, or to the joint maths and physics or maths and theoretical physics options.

For students on a joint programme, then some or all the choice slots above will be occupied by requirements of the other subject.

MSci Chemistry and Physics

Direct entry to second year is not available for students registered for MSci Chemistry and Physics. There are, however, two possible routes through years one and two, depending upon entry qualifications.

1) Taking 1000-level modules in year 1 (numbers in brackets are credits associated with each module):

Year 1, semester 1	***Year 1, semester 2***
CH1401 Introductory Inorganic and Physical Chemistry	CH1402 Inorganic and Physical Chemistry 1
PH1011 Physics 1A	PH1012 Physics 1B
MT1001 Introductory Mathematics	MT1002 Mathematics
Year 2, semester 1	***Year 2, semester 2***
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
CH2501 Inorganic Chemistry 2 (30)	CH2701 Physical Chemistry 2 (30)
MT2501 Linear Mathematics (15)	
MT2503 Multivariate Calculus (15)	

This route requires taking 90 credits in semester one of year two. Students with A in both maths and physics at Advanced Higher or A-level may choose to take 2000-level physics modules in year one to reduce the need to over-credit in year two.

2) For students entering with Advanced Highers in maths, chemistry and physics, all at grade A, or A-levels in maths, chemistry and physics, all at grade A, or qualifications equivalent to these, they may spend year one doing mostly chemistry and year 2 doing mostly physics (numbers in brackets are credits associated with each module):

Year 1, semester 1	***Year 1, semester 2***
CH1202 Chem. For Direct Entrants (10)	CH2601 Organic Chemistry 2 (30)
MT1002 Mathematics (20)	CH2701 Physical Chemistry 2 (30)
CH2501 Inorganic Chemistry 2 (30)	
Year 2, semester 1	***Year 2, semester 2***
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
MT2501 Linear Mathematics (15)	Choice (30)
MT2503 Multivariate Calculus (15)	

(Please note that although most of year 1 here is 2000-level chemistry, this isn't a direct entry route.) This option, where possible, allows students to avoid having to over-credit in year 2, and leaves open more options for single-honours chemistry programmes.

Direct entry to second year: module choices

Please note that as described above, direct entry to second year is only possible for some programmes, and please also note the additional grade requirements.

Students with the necessary qualifications, outlined above on page 3, can opt for direct entry to second year. Please note that the requirements for students registered on BSc Mathematics and Physics, or MPhys Mathematics and Theoretical Physics, are different to the requirements for single-honours degrees.

Students with the necessary qualifications for second year entry should find PH2011 Physics 2A in first semester to be accessible from their prior learning, followed in second semester by PH2012 Physics 2B. These two modules are required for all the degree programmes in our School.

Students intending or considering an Astrophysics programme should also select AS1101 Astrophysics (Direct Entry) which will allow progression to the second semester Astrophysics modules AS2001 or AS2101.

Some students choosing direct entry have a choice of how they start their mathematics study. In recent years most entrants have taken two level-two maths modules in semester one, but there is the possibility for most of doing a level one maths module (MT1002) in semester one, postponing MT2501 Linear Maths or MT2503 Multivariate Calculus to second semester. All students aiming for a degree involving our School will need to take MT2501 Linear Maths and MT2503 Multivariate Calculus during year two.

MT2501 and MT2503 may be taken in either semester, although we'd suggest taking MT2503 in first semester where possible, due to its value to Physics 2B. For the joint programmes with Maths, students will need to select the correct set of MT modules to allow either a pure flavour or applied flavour of the maths component.

Students need to take 120 credits over the year, although it's ok to be 5 or 10 over (as results from some module combinations). A requirement of the degree is that students have at least 80 credits at 2000-level, which is automatically met by the core requirement of MT2501, MT2503, PH2011 and PH2012.

Tables below show possible module combinations for different intended programmes, and what programmes these combinations may also lead to. Some tables are repeated, as the same set of modules can satisfy different intended degree titles. Numbers in brackets are the credit weighting of modules.

1) Taking MT1002 in first semester

For BSc/MPhys **Physics** or MPhys **Theoretical Physics**:

Semester 1	***Semester 2***
MT1002 Mathematics (20)	MT2501 Linear Mathematics (15)
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
MT2503 Multivariate Calculus (15)	Choice (for example, 15 credit 2000-level maths module, or 1000-level module of interest)

A. Can lead to BSc/MPhys Physics, MPhys Theoretical Physics.

For BSc/MPhys **Astrophysics**, BSC/MPhys **Physics** or MPhys **Theoretical Physics**:

Semester 1	***Semester 2***
MT1002 Mathematics (20)	
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
AS1101 Astrophysics (Direct Entry) (5)	AS2101 Astrophysics 2 (15)
MT2501 Linear Mathematics (15)	MT2503 Multivariate Calculus (15)

B. Can lead to any of the School's single honours degree programmes. It is 10 credits over the normal load in semester one, but balanced to some extent by this involving level one modules.

2) Not taking MT1002 in first semester

For Physics or Theoretical Physics:

Semester 1	***Semester 2***
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
MT2501 Linear Mathematics (15)	Choice (30)
MT2503 Multivariate Calculus (15)	

C. Can lead to BSc/MPhys Physics or MPhys Theoretical Physics. If appropriate MT modules are taken as the choice in second semester could also satisfy requirements for a joint degree with applied maths.

Semester 1	***Semester 2***
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
AS1101 Astrophysics (Direct Entry) (5)	AS2001 Astronomy & Astrophysics 2 (30)
MT2501 Linear Mathematics (15)	**OR**
MT2503 Multivariate Calculus (15)	AS2101 Astrophysics 2 (15) and choice (15)

D. Can lead to BSc/MPhys Astrophysics, BSc/MPhys Physics or MPhys Theoretical Physics, that is all the single-honours programmes in the School. Five credits over standard credit load

Semester 1	***Semester 2***
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
MT2503 Multivariate Calculus (15)	MT2501 Linear Mathematics (15)
Choice, for example 2000-level MT module (15) or a 1000-level module (20)	Choice, for example 2000-level MT module (15) or a 1000-level module (20)

E. Can lead to BSc/Mphys Physics or MPhys Theoretical Physics. If appropriate MT modules are taken as the choices, could also satisfy requirements for a joint degree with pure maths.

For Astrophysics:

Semester 1	***Semester 2***
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
AS1101 Astrophysics (Direct Entry) (5)	AS2001 Astronomy & Astrophysics 2 (30)
MT2501 Linear Mathematics (15)	**OR**
MT2503 Multivariate Calculus (15)	AS2101 Astrophysics 2 (15) and choice (15)

F. Can lead to BSc/MPhys Astrophysics, BSc/MPhys Physics or MPhys Theoretical Physics, ie all the single-honours programmes in the School. Five credits over standard credit load.

Semester 1	***Semester 2***
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
AS1001 Astronomy & Astrophysics 1 (20)	AS2101 Astrophysics 2 (15)
MT2501 Linear Mathematics (15)	MT2503 Multivariate Calculus (15)

G. Can lead to BSc/MPhys Astrophysics, BSc/MPhys Physics or MPhys Theoretical Physics, that is all the single-honours programmes in the School. Five credits over standard credit load.

For Physics and (Applied) Maths:

Semester 1	***Semester 2***
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
MT2501 Linear Mathematics (15)	MT2506 Vector Calculus (15)
MT2503 Multivariate Calculus (15)	MT2507 Mathematical Modelling (15)

H. Can lead to BSc/MPhys Physics, BSc Maths and Physics, MPhys Maths and Theoretical Physics.

For Physics and (Pure) Maths:

Semester 1	***Semester 2***
PH2011 Physics 2A (30)	PH2012 Physics 2B (30)
MT2503 Multivariate Calculus (15)	MT2501 Linear Mathematics (15)
MT2502 Analysis (15)	MT2505 Abstract Algebra (15)

I. Can lead to BSc/MPhys Physics, BSc Maths and Physics, MPhys Maths and Theoretical Physics. MT2501 and MT2503 could be taken in the opposite order.

Module choices and timings

The timings of AS and PH modules can be found on the School website, and for modules in other Schools timings can be found in the University's module catalogue.

Looking ahead

We have comments from some of our graduates about their careers on the School's website. The University Careers Centre has a wealth of information online. Graduates from all our programmes have acquired a wide range of knowledge and skills in physics and mathematics, and IT skills that can make them attractive to research/development/sales in physics-based industry, medical physics, patent agencies, education, computing, financial services, etc. The more general graduate and professional skills that are developed as part of the degree programme also open up more general "any graduate" career options.

All our programmes can lead to post-graduate study for a research degree such as a PhD or EngD. If you know that you would like to do a PhD in a particular area (astronomy, physics, theoretical physics, etc) then it is probably worth considering doing a named degree in that area, but students who do well in their programme are likely to find that they can move from one area to another given the underlying core material that is in all the programmes. A PhD can lead on to research work in universities or in industry, or a wider range of career opportunities inside or outside physics and astronomy.

Once in the Honours years students have core modules and a set of modules from which they can choose, depending on the flavour of their degree programme. Our honours modules are informed by the research being carried out in the School, as well as on-going work on physics education. There are opportunities to get directly involved in this research. Our single- and joint-honours degree programmes are all accredited by the UK Institute of Physics.

The different programmes all include modules that cover the core of physics. All students in honours will study quantum mechanics, thermal and statistical physics, electromagnetism, nuclear and particle physics, and computational techniques. All honours students do additional work on mathematical techniques, including in our Maths for Physicists module and possibly also with the School of Mathematics and Statistics. All students do a final-year project. For those doing a single honours degree the project will often be with one of the School's research teams running a particular investigation or development. All students doing a degree wholly within the School will take the module "Transferable Skills for Physicists", in which they develop advanced research/professional skills at the same time as gaining credit for investigating areas of science of particular interest to them; students on the joint degrees do some of this work within an extended module that also includes nuclear physics or in a 5 credit module for joint degree students with chemistry.

The astrophysics programmes apply these core ideas along with the material in second level astrophysics to investigate the universe around us. Computational, observational, and theoretical skills and knowledge are developed in this programme. A highlight was the discovery by students on the observational astrophysics module of a new extra-solar planet as part of their work.

The physics honours programmes provide a wide range of modules. Students on these programmes have a set of core modules and a wide choice of others. These are usually the programmes within the School with the most students. Students include in their programme two laboratory modules in which they can explore aspects of physics and develop relevant laboratory skills. In recent years some physics students have been amongst the top in Europe in “Physics Student of the Year” type competitions, based primarily on the work in their final year projects.

The theoretical physics programme allows the development of mathematical physics to a high level. These students do not usually do the laboratory modules, instead spending additional time on topics such as special relativity and quantum field theory. A highlight was the international recognition of a student doing a theoretical physics project for his development of new ideas in invisibility cloaks.

The single-honours degree programmes can have a fair amount of choice within them, particularly in fourth year and (where relevant) the final year of an integrated masters programme. This allows students to choose modules of particular interest to them.

The joint degree programmes allow students to spend about half their time in the Honours years on physics and about half their time on another subject. This can allow good access to work at the interfaces between disciplines. The MSci Chemistry and Physics students spend third year doing entirely Chemistry modules and fourth year doing entirely Physics, with the 5th year a combination of chemistry and physics. The joint degrees with Mathematics are also popular, and the two schools continue to work together to allow students to create useful joint programmes. Those students with an interest in philosophy can take the joint degree with that school, developing their ways of thinking and looking at the world from both a physical and a philosophical viewpoint.

Doing a joint degree necessarily means that there is less time available for physics and astronomy modules due to having only about half the honours credits from this School. For the MSci Chemistry and Physics the physics modules taken before 5000-level are almost fixed. The BSc Philosophy and Physics programme has the physics content of third year defined, but there is room for some choice of physics modules in fourth year. The BSc joint degree with Maths has some choice of physics modules. The MPhys joint degree with Maths has some choice of physics modules in fourth year, and a wider choice in the final year, where students can choose to do a project in either mathematics or theoretical physics. The reduced choice of PH modules in joint degrees is of course balanced by the introduction of relevant and interesting modules from the other discipline.

All our degree programmes should develop the thinking, numeracy, research, and problem-solving skills that are crucial to many future career opportunities. When considering which of our programmes you may wish to do, please consider which you are going to find most interesting.

Preparation

There is additional maths support material particularly aimed at preparing students for second year maths modules available on a self-enrolment Moodle course

https://moody.st-andrews.ac.uk/moodle/course/view.php?id=18645

The course is good preparation for MT2501 and MT2503, and may also be useful reference material while studying on these modules. There is no obligation to complete any of the work, which is not assessed and for interest only. It includes a number of quizzes which are auto-graded for informal feedback and can be done repeatedly.

Study Skills

Physics and Astronomy, in common with most other worthwhile learning, needs study, practice, reflection, and further work for a student to come to terms with the material and gain the ability to use it (and to pass exams). In the same way that merely buying a textbook does not result in the owner being competent in using the material contained within it, merely turning up to lectures is not enough to understand and learn how to use ideas in physics and astronomy. There is a good deal of support available for learning here in terms of staff time, fellow students, online and paper-based resources, libraries and IT suites, teaching labs and lecture rooms, but it is up to every student to organise themselves to do what is necessary for their own learning.

We are aware that our students have all achieved great things in their previous studies and keen that high achievement carries on here. Some students join us having not had to study particularly hard to pass their school exams; some of them may be at particular risk of not putting in the thought and effort needed in their university studies.

First and second year mathematics and physics modules are the foundations on which the honours-level modules are based. We wish our students to be familiar with and remain competent in their school/college and pre-honours material throughout their degree programme here.

Additional Information

The School's Pre-Honours and Honours handbooks will be made available online. Students are expected to read these documents, which as well as containing useful information are the "rule-books" for the first- and second-year modules in the School.

Your adviser of studies will be happy to answer queries you may have.

There may be errors in this document. The University's official publications and your adviser should be consulted. Errors and Omissions Excepted. Module availability may change from session to session.

Lucy Hadfield, August 2024