

## Programme Specification

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### MPhys Astrophysics with a Year Abroad (2020-21)

This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided.

Awarding Institution	University of Southampton
Teaching Institution	University of Southampton
Mode of Study	Full-time
Duration in years	4
Accreditation details	Institute of Physics (IOP)
Final award	Master of Physics (MPhys)
Name of award	Astrophysics with a Year Abroad
Interim Exit awards	Bachelor of Science with Honours (BSc (Hons)) Certificate of Higher Education (CertHE) Diploma of Higher Education (DipHE)
FHEQ level of final award	Level 7
UCAS code	N/A
Programme code	4422
QAA Subject Benchmark or other external reference	Physics, Astronomy and Astrophysics 2019
Programme Lead	Malcolm Coe

## Programme Overview

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### Brief outline of the programme

Physics and astronomy are dynamic subjects which are continually being developed by new discoveries and innovations. In choosing to study physics at Southampton, you will benefit from being taught by research-active physicists who enjoy an outstanding international reputation in all research areas carried out within Physics & Astronomy. We assign a high priority to the continual development and improvement of our teaching methods and curriculum design in order to guarantee students a highly stimulating, as well as enjoyable and fruitful, learning experience.

Astronomy is one of the strong research features of Southampton and students greatly benefit from extensive contact with staff involved in cutting-edge research. This is particularly true for final year projects that often

involve working with the latest results from international observatories. In addition Southampton has pioneered the award-winning field trip to the Izana Observatory in Tenerife. This provides Astrophysics students with an opportunity to carry out observational work at an international professional observatory.

In the fourth year you spend 30 weeks working in a research laboratory abroad. This will take place in the Harvard-Smithsonian Center for Astrophysics, Boston, USA starting 1 September. During this period of time you will be under the immediate supervision of a local member of staff who will guide you in your work on a previously agreed programme of study. A member of staff from Southampton will visit you during your first 3 months to ensure satisfactory progress. At all stages both the Personal Tutor and Southampton Programme co-ordinator will proactively maintain communication with you.

Physics & Astronomy recognises the potential diversity of our students both at home and internationally and thus this document has been written in accordance with the University's Diversity Policies and current anti-discrimination legislation.

Exit awards are only available under exceptional circumstances. Note that students must meet the standard criteria for progression to these awards before they can be granted. In the case of the CertHE and DipHE, core modules for the BSc Physics are treated as compulsory modules for the purpose of deciding whether progression to these awards has been accomplished.

\*The BSc Physics exit award cannot be guaranteed for this programme.

Your contact hours will vary depending on your module/option choices. Full information about contact hours is provided in individual module profiles.

### **Learning and teaching**

Core knowledge and understanding is acquired substantially via lectures, supported by tutor-led tutorials, laboratory practical classes, problem classes, as well as guided independent study and research. Some modules may involve field-trips led by academic staff. Students are strongly encouraged to attend all the lectures for the courses on which they are registered and are required to attend all the supporting sessions.

### **Assessment**

Assessment in the first, second and third year is a mixture of unseen written examinations, marked problem sheets and laboratory work. In their 3rd year in Southampton, the students take all the core material from the 3rd and 4th years of the normal MPhys programme. In the fourth year the students carry out a research project abroad. The aim of the year abroad is to enable first class students to take part in genuine research that will challenge their skills and knowledge in astrophysics. Assessment for this year will be by two reports (one halfway through and one at the end), a viva and a seminar presentation.

## **Special Features of the programme**

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N/A

**Please note:** As a research-led University, we undertake a continuous review of our programmes to ensure quality enhancement and to manage our resources. As a result, this programme may be revised during a student's period of registration; however, any revision will be balanced against the requirement that the student should receive the educational service expected. Please read our [Disclaimer](#) to see why, when and how changes may be made to a student's programme.

Programmes and major changes to programmes are approved through the University's [programme validation process](#) which is described in the University's [Quality handbook](#).

## **Educational Aims of the Programme**

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The aims of the programme are to:

- introduce you to the main branches of physics;
- help you to understand the principles of physics;
- provide you with a foundation for a successful career as a physicist, and opportunities to develop skills transferable to a wide range of other careers, and to prepare you for further studies in physics leading to a graduate degree such as a Ph.D.;
- offer you the opportunity to study some of the advanced concepts and techniques of contemporary physics, particularly in astronomy and photonics;
- enable you to develop skills in problem solving and critical and quantitative analysis in physics;
- enable you to develop practical skills in experimentation and measurement;
- provide you with the opportunity for a broader education by studying other subjects in addition to physics;
- provide you with a friendly and supportive environment and enrich your learning experience through interaction with staff engaged in internationally respected research;
- provide you with some of the basic IT and numeracy skills necessary for further study and employment, including word-processing, data analysis and internet-based research;
- enable you to develop computer programming skills and statistical techniques to support data analysis;
- help you develop key skills: personal organisation and teamwork, finding and using information, written and oral presentation;
- ensure that you become an increasingly independent learner and physicist as you progress through the programme.
- explain to you the challenges involved in carrying out ground-based and space-based observations of the fundamental parameters of the universe.
- give you the opportunity to study some advanced concepts in contemporary astrophysics
- ensure that you become an increasingly independent learner and physicist as you progress through the programme

## Programme Learning Outcomes

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Having successfully completed this programme you will be able to demonstrate knowledge and understanding of:

### Knowledge and Understanding

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On successful completion of this programme you will have knowledge and understanding of:

- A1. mathematics required for the description of the physical world;
- A2. the breakdown of classical (19th century) physics and the revolution in physics at the beginning of the 20th century;
- A3. special relativity and its application in nuclear physics and high-energy particle scattering;
- A4. the quantitative description of oscillating systems and wave-motion;
- A5. Newtonian mechanics and its application to physical systems;
- A6. quantum theory, both from qualitative and quantitative (quantum mechanics) viewpoints;
- A7. application of quantum theory to describe the structure of atoms and nuclei;
- A8. the laws of thermodynamics and their consequences for the behaviour of physical systems;
- A9. statistical mechanics as a basis for the microscopic description of thermodynamic systems;
- A10. electricity, magnetism and their unification through the laws of electromagnetism;
- A11. a wide range of physics experimental techniques;

- A12. electromagnetic waves and optics;
- A13. quantum theory applied to relativistic systems;
- A14. advanced classical and quantum mechanics and electromagnetism;
- A15. specific topics selected for a dissertation and final year project.
- A16. planetary, galactic, and extra-galactic astronomy, and cosmology;
- A17. the design and operation of astronomical detectors across the electromagnetic spectrum;
- A18. the motion of stars and solar system objects across the night sky throughout the year;

### **Teaching and Learning Methods**

The topics listed in skills A1–A18 are taught mainly via lectures, directed reading and laboratory work as part of the core modules associated with this programme. Learning is reinforced via tutorials (in Part I), project work (particularly in the final research year), coursework and problems classes.

### **Assessment Methods**

The topics listed in skills A1–A18 are assessed via a range of assessment methods. Assessment in the first and second year is a mixture of unseen written examinations, marked problem-based coursework and laboratory work. For the MPhys programmes, assessment in the third year is mainly by examination, although laboratory- based, computer-based and dissertation modules will use different assessment methods, as appropriate. In the fourth year of this programme, a year-long research project is assessed using continuous assessment, written reports and an oral examination.

### **Subject Specific Intellectual and Research Skills**

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On successful completion of this programme you will be able to:

- B1. apply knowledge of physics to the solution of theoretical and practical physical problems;
- B2. apply mathematical techniques in algebra, vectors, calculus and differential equations to the solution of physical problems;
- B3. program and use computers to assist in the solution of physical problems;
- B4. carry out a literature search for relevant material for the preparation of dissertations;
- B5. assimilate new material independently;
- B6. prepare and deliver seminars on specific subjects;
- B7. interpret data using statistical techniques and make decisions taking into account experimental errors.

### **Teaching and Learning Methods**

Problem solving (items B1-B3) is at the heart of physics, and so it is emphasized throughout the learning

and teaching experience, in lectures, coursework and problem classes. Mathematics skills (item B2) are developed via core maths modules in Part I and the use the techniques learned in physics core modules in Parts I-III. Computer skills (item B3) are developed via a core part I computing module (PHYS1201), and part of the core laboratory module (PHYS2022), interpretation and associated decision making (item B4) are developed primarily via core laboratory modules in Parts I and II, but usually also developed further in the final year project, which is also core.

## **Assessment Methods**

Problem solving and mathematical skills (items B1-B2) are assessed mostly via written examinations, but also via assessed coursework, especially in Parts I and II of the programme. Problem-solving (B1), in particular, is also a key aspect of the final year project, which is assessed via supervisor's judgment of research work, a written report and an oral examination. The computing part of the core laboratory (B3) module in Part II is assessed via practical exercises. Data interpretation and related decision making (B4) are assessed via practical work, vivas and presentations in the Part 1-3 laboratory modules. They are also assessed implicitly in many/most final year projects.

## **Transferable and Generic Skills**

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On successful completion of this programme you will be able to:

- C1. communicate physical ideas in written form;
- C2. recognise the value of numeracy in the precise statement of ideas;
- C3. prepare and give an oral presentation using visual aids;
- C4. prepare a scientific report using appropriate computer tools for document preparation, data analysis and graphical display;
- C5. use information from a variety of sources including scientific journals, books and the internet;
- C6. manage a project with due attention to time and resource management;
- C7. work successfully as a team member.

## **Teaching and Learning Methods**

Skill C1 is covered mainly via self-study (with help and feedback available) in the Physics Skills/Physics from Evidence lab modules (via write-ups), in the final year project (which is partly assessed via a written report), and (for the MPhys) the dissertation module. Skill C2 is embedded throughout the curriculum, with practical applications in experimental and project work. Skill C3 is covered the Part II Physics from Evidence laboratory module, which includes a "conference" component, during which students give an assessed presentation on your laboratory work at a mock scientific conference. It is also covered (for MPhys students) in the dissertation module, which includes a presentation associated with the teamwork component. Skill C4 is covered in laboratory and project work, as well as the dissertation module (for MPhys students). Skill C5 is covered by the final year project, as well as the dissertation module (for MPhys students). Skill C6 is developed especially during the final year project, but also during the dissertation module (for Mphys students). Skill C7 is developed during all lab modules (which typically are done in pairs), during the final year project (again, this is usually done in pairs), and particularly during the dissertation module (which includes a team work component).

## Assessment Methods

Skill C1 is assessed with written reports on experimental work in laboratory modules, via the written report required for the final year project, and (for the MPhys) via the written report required for the dissertation module.

Skill C2 is assessed in a variety of ways throughout the programme - it is an ingredient in everything from formal exams, to oral examinations, to written reports and presentations.

Skill C3 is assessed via a presentation students give during a mock scientific conference which is part of the Part II Physics from Evidence laboratory module.

Skill C4 is assessed in the marking of all written coursework and reports, such as laboratory and project work, and also the report for the dissertation module (for MPhys students).

Skill C5 is assessed as an explicit component in the mark scheme for the final year project report, and also in the report for the dissertation module (for MPhys students).

Skill C6 is assessed primarily via the supervisor's mark on the final year project performance, but of course also via the report on the project (and, for MPhys students) the dissertation module.

For MPhys students, skill C7 is assessed explicitly via the team work component of the final year project. The mark for this is assigned by the module coordinator, but takes into account team members assessment of each other's contribution. For the final year project, team work can also be a factor in a supervisor's assessment.

## Subject Specific Practical Skills

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On successful completion of this programme you will be able to:

- D1. use standard laboratory apparatus for physical measurements;
- D2. use computers for the acquisition, storage, and analysis of data.

## Assessment Methods

The fundamentals for skill D2 are introduced in a core Part I module (PHYS1201) and assessed via coursework. Skill D1 is developed and assessed primarily via the core laboratory modules in Parts I and II. Skill D2 is developed and assessed during the laboratory modules, especially the Part II Physics from Evidence module, which includes a computing component.

## Programme Structure

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The programme structure table is below:

Information about pre and co-requisites is included in individual module profiles.

Where optional modules have been specified, the following is an indicative list of available optional modules, which are subject to change each academic year. Please note in some instances modules have limited spaces available.

### Part I

The following structure assumes entry via the MPhys with Astronomy programme, having taken the by-invitation module PHYS2011 in Part II.

The information in this programme specification is accurate at the time of writing, but may change in minor ways from year to year due to staff availability or other factors. Some of these modules are subject to pre-requisites and exclusions that, for brevity, are not given here; this information is available in the module specifications on the Physics & Astronomy Undergraduate Teaching website.

The module requirements for each programme are shown for each Part below; modules are either core (must be taken and passed), compulsory (must be taken) or optional (may be taken).

It should be noted that it may not be possible to run some optional modules if the number of students registered on the module is very small. It should also be noted that optional module choice can be restricted by the University Timetable, which varies from year to year: some optional modules may clash with other optional or compulsory modules. Please be aware that many modules are shared between different cohorts; the class size depends on cohort size, which varies from year to year.

### Part I Core

You will take the following core modules:

Code	Module Title	ECTS	Type
PHYS1022	Electricity and Magnetism	5	Core
PHYS1013	Energy and Matter	5	Core
PHYS1005	Introduction to Astronomy and Space Science	7.5	Core
MATH1006	Mathematical Methods for Physical Scientists 1a	7.5	Core
MATH1007	Mathematical Methods For Physical Scientists 1b	7.5	Core
PHYS1015	Motion and Relativity	5	Core

PHYS1201	Physics Skills - Programming and Data Analysis	7.5	Core
PHYS1017	Physics Skills 1	5	Core
PHYS1019	Physics Skills 2	5	Core
PHYS1011	Waves, Light and Quanta	5	Core

## Part II

You must complete the following modules.

### Part II Core

Code	Module Title	ECTS	Type
PHYS2006	Classical Mechanics	7.5	Core
PHYS2011	Design and Observation in Astronomy	7.5	Core
PHYS2001	Electromagnetism	7.5	Core
PHYS2013	Galaxies	7.5	Core
PHYS2022	Physics from Evidence I	7.5	Core
PHYS2003	Quantum Physics	7.5	Core
PHYS2024	Statistical Mechanics	7.5	Core
PHYS2023	Wave Physics	7.5	Core

## Part III

### Part III Compulsory

Code	Module Title	ECTS	Type
PHYS6017	Computer Techniques in Physics	7.5	Compulsory
PHYS6005	Cosmology	7.5	Compulsory

### Part III Core

You must complete the following modules.

Code	Module Title	ECTS	Type
PHYS3008	Atomic Physics	7.5	Core
PHYS3004	Crystalline Solids	7.5	Core
PHYS3002	Nuclei and Particles	7.5	Core
PHYS3011	Photons in Astrophysics	7.5	Core
PHYS3010	Stellar Evolution	7.5	Core
PHYS3007	Theories of Matter, Space and Time	7.5	Core

### Part IV

#### Part IV Core

Code	Module Title	ECTS	Type
PHYS6013	Research Thesis - Astrophysics	60	Core

### Progression Requirements

The programme follows the University's regulations for [\*Progression, Determination and Classification of Results : Undergraduate and Integrated Masters Programmes\*](#) and [\*Progression, Determination and Classification of Results: Postgraduate Master's Programmes\*](#) Any exemptions or variations to the University regulations, approved by AQSC are located in [\*section VI of the University Calendar\*](#).

### Support for student learning

There are facilities and services to support your learning some of which are accessible to students across the University and some of which will be geared more particularly to students in your particular Faculty or discipline

area.

The University provides:

- library resources, including e-books, on-line journals and databases, which are comprehensive and up-to-date; together with assistance from Library staff to enable you to make the best use of these resources
- high speed access to online electronic learning resources on the Internet from dedicated PC Workstations onsite and from your own devices; laptops, smartphones and tablet PCs via the Eduroam wireless network. There is a wide range of application software available from the Student Public Workstations.
- computer accounts which will connect you to a number of learning technologies for example, the Blackboard virtual learning environment (which facilitates online learning and access to specific learning resources)
- standard ICT tools such as Email, secure filestore and calendars.
- access to key information through the MySouthampton Student Mobile Portal which delivers timetables, Module information, Locations, Tutor details, Library account, bus timetables etc. while you are on the move.
- IT support through a comprehensive website, telephone and online ticketed support and a dedicated helpdesk in the Hartley Library.
- Enabling Services offering support services and resources via a triage model to access crisis management, mental health support and counselling. Support includes daily Drop In at Highfield campus at 13.00 – 15.00 (Monday, Wednesday and Friday out of term-time) or via on-line chat on weekdays from 14.00 – 16.00. Arrangements can also be made for meetings via Skype.
- assessment and support (including specialist IT support) facilities if you have a disability, long term health problem or Specific Learning Difficulty (e.g. dyslexia).
- the Student Services Centre (SSC) to assist you with a range of general enquiries including financial matters, accommodation, exams, graduation, student visas, ID cards
- Career and Employability services, advising on job search, applications, interviews, paid work, volunteering and internship opportunities and getting the most out of your extra-curricular activities alongside your degree programme when writing your CV
- Other support that includes health services (GPs), chaplaincy (for all faiths) and 'out of hours' support for students in Halls and in the local community, (18.00-08.00)
- A Centre for Language Study, providing assistance in the development of English language and study skills for non-native speakers.

The Students' Union provides

- an academic student representation system, consisting of Course Representatives, Academic Presidents, Faculty Officers and the Vice-President Education; SUSU provides training and support for all these representatives, whose role is to represent students' views to the University.
- opportunities for extracurricular activities and volunteering
- an Advice Centre offering free and confidential advice including support if you need to make an academic appeal
- Support for student peer-to-peer groups, such as Nightline.

Associated with your programme you will be able to access:

- All students have a personal academic tutor, with whom they meet regularly, particularly during the first year where small group tutorials are used to discuss the core physics courses and associated coursework/problem sheets. Tutors offer help on both academic matters, such as choice of option courses, and on pastoral matters.
- The Year Directors of Studies, the Director of Programmes, as well as the Senior Tutor are available to give help and advice as required.
- One of the primary functions of the Faculty Office is student support and guidance. The Faculty Office is able to provide information on wide range of topics, including programme regulations, special consideration procedures, appeals, and much more.
- The student physics society Physoc organizes a "parenting" scheme in which all new arrivals are looked after by senior physics students. Physoc also runs an academic mentoring scheme that aims to provide academic tutoring, help and advice for students by students.
- In the first and second year, each core module has an associated compulsory problems class where demonstrator provide individual help on the course material and/or coursework;
- Students normally work in pairs on final year projects, which are supervised by a member of academic staff who is likely to be an internationally respected expert.
- Most modules provide printed lecture notes that are either distributed or are available online.
- Key transferable skills are embedded throughout our courses, particularly those which contain coursework or laboratory work.
- Provision is made for any student who specifically wishes to consult a female member of staff.
- We are proud of the friendly atmosphere in Physics & Astronomy. Members of staff are happy to be approached for help. The Faculty Office also provides support for students throughout their programmes.

## Methods for evaluating the quality of teaching and learning

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You will have the opportunity to have your say on the quality of the programme in the following ways:

- Completing student evaluation questionnaires for each module of the programme.
- Acting as a student representative on various committees, e.g. Staff/Student Liaison Committees, School Programmes Committee OR providing comments to your student representative to feedback on your behalf.
- Serving as a student representative on Faculty Scrutiny Groups for programme validation.
- Taking part in programme validation meetings by joining a panel of students to meet with the Faculty Scrutiny Group.

Further details on the University's quality assurance processes are given in the [Quality Handbook](#).

## Career Opportunities

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### Careers Support

We believe in helping our students gain the necessary experience for a future career, along with the skills to identify opportunities and make the most of them. At Southampton, you will have the opportunity to broaden your options by meeting employers, getting involved in volunteering activities, work placements and much more.

We work hard to help our students enter exciting careers. Our Academic Careers Team, supported by our student society (PHYSOC), put on over 40 hours a year of careers advice ranging from helping you write your CV, to advice on how to set up a small business, to mock interviews supported by real companies. We work with our students to find them placements and internships, which will help them to gain valuable work experience, preparing them for employment when they graduate. In 2012, 86% of our students began a career within six months of graduating.

We are part of South East Physics Network (SEPNet,) who we work with to organise eight-week paid internships for our students during the summer vacation. In previous years, students have been placed with a wide range of organisations, including The National Physical Laboratory, BMW, The Met Office, SELEX Galileo, QinetiQ, the Culham Centre for Fusion Energy. As well as offering employment opportunities, these companies offer advice to our students about how to become more competitive in the work place.

SEPNet has a dedicated Careers Adviser who our students can liaise with. We work with SEPNet to offer our students the chance to attend 'meet the employer' days as well as careers talks with speakers from industry.

## External Examiner(s) for the programme

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Name: Professor Haley Gomez - University of Cardiff

Name: Professor Simon Cornish - Durham University

Students must not contact External Examiner(s) directly, and external examiners have been advised to refer any such communications back to the University. Students should raise any general queries about the assessment and examination process for the programme with their Course Representative, for consideration through Staff: Student Liaison Committee in the first instance, and Student representatives on Staff: Student Liaison Committees will have the opportunity to consider external examiners' reports as part of the University's quality assurance process.

External examiners do not have a direct role in determining results for individual students, and students wishing

to discuss their own performance in assessment should contact their Personal Academic Tutor in the first instance.

**Please note:** This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if they take full advantage of the learning opportunities that are provided. More detailed information can be found in the programme handbook.

## Appendix 1:

Students are responsible for meeting the cost of essential textbooks, and of producing such essays, assignments, laboratory reports and dissertations as are required to fulfil the academic requirements for each programme of study. In addition to this, students registered for this programme also have to pay for:

### Additional Costs

Type	Details
Approved Calculators	Candidates may use calculators in the examination room only as specified by the University and as permitted by the rubric of individual examination papers. The University approved models are Casio FX-570 and Casio FX-85GT Plus. These may be purchased from any source and no longer need to carry the University logo.
Fieldwork: logistical costs	PHYS2011: The field trip component takes place over two consecutive weeks within the Easter break, at the premises of the University of La Laguna, Tenerife and at the Observatorio del Teide, Tenerife. While the field trip is heavily subsidised by the faculty, a student contribution to the costs is required; in academic year 2016-17, this is £450 per student. Flight costs, all local travel costs in Spain, and all hotel accommodation costs during the week in La Laguna, all costs of staying at the residencia at the observatory, as well as all food costs during week 2 at the observatory are included. The only unavoidable additional costs students will incur in Spain are food costs during the day in the first week. Any student who genuinely cannot afford to pay the student contribution for some reason should contact the course co-ordinator to discuss this privately.
Placements (including Study Abroad Programmes)	PHYS6013: For AY 2016/17 onwards: The stay at Harvard will typically be for 9 months. Rentable home accommodation is available, and tuition fees will be charged at 15% of the standard level. A £500 Southampton Opportunity scholarship will be awarded to help cover for the difference in living costs between Southampton and Boston and the purchase of at least one return flight.
Printing and Photocopying Costs	In the majority of cases, coursework such as essays; projects; dissertations is likely to be submitted on line. However, there are some items where it is not possible to submit on line and students will be asked to provide a printed copy.
Stationery	You will be expected to provide your own day-to-day stationary items, e.g. pens, pencils, notebooks, etc). Any specialist stationery items will be specified under the Additional Costs tab of the relevant module profile.
Textbooks	Where a module specifies core texts these should generally be available on the reserve list in the library. However due to demand, students may prefer to buy their own copies. These can be purchased from any source. Some modules suggest reading texts as optional background reading. The library may hold copies of such texts, or alternatively you may wish to purchase your own copies. Although not essential reading, you may benefit from the additional reading materials for the module.

In some cases you'll be able to choose modules (which may have different costs associated with that module) which will change the overall cost of a programme to you. Details of such costs will be listed in the Module Profile. Please also ensure you read the section on additional costs in the University's Fees, Charges and Expenses Regulations in the University Calendar available at [www.calendar.soton.ac.uk](http://www.calendar.soton.ac.uk).

