University of Glasgow | School of Physics & Astronomy

Physics 1 (PHYS1001)

Course Information Guide 2023-24

The Physics 1 (P1) course is an introductory class for students intending to proceed to an Honours degree in Physics, either on its own or combined with another subject. This course is also recommended for those intending to study other physical sciences who want to include physics in their curriculum.

Contents

1 Welcome statement from Head of School

As the Head of School of Physics and Astronomy, I would like to welcome you to your new class. The School prides itself in providing an excellent and supportive learning and teaching environment that is fully integrated with our research; you will have the opportunity to interact with world-leading researchers working at the cutting edge of a wide range of fields of physics and astronomy, who are tackling some of the biggest contemporary challenges in science and technology.

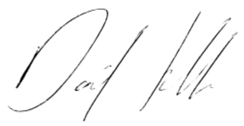
During the pandemic, our staff developed new ways of delivering high quality learning and teaching, and have been working to combine these with our traditional approaches. This is an ongoing process of development, and I ask that you engage with us through any of the available communication channels in letting us know what works and what does not.

One thing that will not change is the School's firm commitment to supporting equally the careers and development of all its students and staff, as exemplified by our receipt of an Athena Swan Silver award. We value the diversity of our student body and recognise that this diversity improves the quality of our work by bringing a wide range of skills and viewpoints. We therefore expect that all staff and students will work productively and professionally together in an atmosphere of mutual respect.

To support this, all our staff and graduate students undertake equality and diversity training, our lab guides include a code of conduct for students, supplementing the University code[1], and we support the University's Dignity at Work and Study policy[2]. You can be assured that any instances of bullying, harassment, or offensive language or behaviour will be both taken seriously by the School and treated with sensitivity. Points of support for students are your adviser of studies, your Class Head and Lab Head, and in addition the School has two appointed Equality and Diversity offices, to whom students may speak in confidence.

I wish you success with your current and future studies

Best wishes



Professor David Ireland
Head of School

[1] University of Glasgow - MyGlasgow - Academic Policy & Governance - Student Contract
[2] https://www.gla.ac.uk/myglasgow/humanresources/equalitydiversity/dignityworkstudyover/

2 General Information and Introduction

The P1 class has daily lectures Mondays to Fridays at 0900 and 1300. You only need to attend one of these lectures per. Please see the Course Timetable on the course Moodle site for details of which topics are on which days, and where those lectures will be held.

Students must also attend one three-hour session in the laboratory most weeks at 2pm – 5pm as arranged. Details of the laboratory timetable will be provided through Moodle and via in Laboratory Course Guide.

2.1 Communication

All information about the class will be communicated via the P1 class Moodle site linked from http://moodle2.gla.ac.uk/course/view.php?id=4311. **You will automatically be registered for access to the P1 Moodle site.** The login ID and password are those you use to access all University computers, including your student email account. You must regularly check the Moodle site for new information. You are also encouraged to make use of the discussion forums that are set up on the site, both for social and physics-related interactions.

2.2 Contacts

Class Head :	Dr Peter H. Sneddon Room 251a, Tel 0141 330 5312 email: peter.sneddon@glasgow.ac.uk
Deputy Class Head:	Dr Caroline Muellenbroich Room: 233a, Tel 0141 330 2395 email: caroline.muellenbroich@glasgow.ac.uk
Laboratory Head :	Dr Pedro Parreira Room 216a, Tel 0141 330 6020 PedroMiguel.RaimundoParreira@glasgow.ac.uk
Deputy Laboratory Head:	Dr Richard Bowman Room 308, Tel 0141 330 4712 Richard.Bowman@glasgow.ac.uk
Technician	Claire Neilan Room 219, Tel 0141 330 2000 ext 0037 Email: claire.neilan@glasgow.ac.uk
Administration:	Michael McKenna Email: physics1-admin@glasgow.ac.uk

If you have any general questions about your course or your degree, you can always contact your own Adviser of Studies. If you have any trouble contacting them, you can also contact the School's Senior Adviser of Studies or the College's Chief Adviser of Studies for Science. Their contact details are:

Senior Adviser for Physics & Astronomy	Dr Donald MacLaren Email: phas-senioradviser@glasgow.ac.uk
Chief Adviser of Studies for Science:	Dr Peter H. Sneddon email: science-chief-adviser@glasgow.ac.uk

2.3 Pre- and co-requsites

For admission to P1, students are normally required to have a pass in both Mathematics and Physics at SQC Higher grade or equivalent. Students must also be enrolled on Mathematics 1 (MATH1017) in the same year as P1.

Anyone not satisfying these conditions should discuss their situation with the Class Head as soon as possible.

3 Course aims and delivery

PHYS1001 (40 credits over Semester 1 and Semester 2) forms the introductory class for students intending to proceed to an Honours degree in Physics, single or combined. The aim of the course is to give such students a good basic understanding of the main physics topics and an introduction to the methods of experimental physics, thereby providing a firm foundation for further study in physics. For those students not intending to take Physics to Honours standard the class will provide a good foundation of basic physics that is applicable to other areas of science and technology.

PHYS1002 (20 credits over Semester 1 only) is designed as a mechanism for students who opt to leave the 40-credit full-year course mid academic year. It is NOT available to any student in Semester 2. Students should attempt all first semester labs and assignments as well as the end of first semester class test. Students should also attempt the single 90 minute degree exam paper in April/May (co-located in space-time with the first paper taken by the PHYS1001 class), with a resit opportunity in August. Assessments in PHYS1002 are weighted the same as for PHYS1001. All pre- and co-requisites stated for PHYS1001 apply to PHYS1002, as the minimum requirements for the award of credits.

3.1 Intended Learning Outcomes

On completion of the course students are expected to:

- have a basic understanding of the laws of physics, and know how and when to apply them in various contexts;

- be able to think clearly and apply their knowledge of basic physics to solve simple problems and present the solutions in a clear and concise manner;
- have an appreciation of some of the many applications of physics in modern technology;
- have acquired and developed experimental skills including the use of a variety of physics apparatus, the taking of data, and their interpretation and analysis;
- have developed skills in the presentation of clear and concise written accounts of laboratory work, employing computer word-processor and spreadsheet applications where appropriate.

3.2 Content delivery

3.2.1 Lecture courses

The 6 lecture courses (3 per semester) are designed to give you a good basic understanding of the main areas of physics. Each course will contain topics that will be familiar from school as well as ones that may be new to you, such as special relativity, lasers and particle physics. Lecture demonstrations and worked examples will be included, to illustrate both basic principles and modern applications of many of the topics.

Details of the aims and objectives and content of these courses can be found later in this document and on the Physics 1 Moodle site.

SEMESTER 1		
Optics, Waves & Lasers I	Prof Andrew Harvey	8 lectures (incl. 1 tutorial)
Optics, Waves & Lasers II	Dr Peter H. Sneddon	8 lectures (incl. 1 tutorial)
Dynamics and Relativity I	Dr Chris Bouchard	9 lectures (incl. 1 tutorial)
Dynamics and Relativity II	Dr Eric Yao	9 lectures (incl. 1 tutorial)
Thermal Physics	Dr Sarah Croke	8 lectures (incl. 1 tutorial)
Frontiers: *Muon Topography*	Dr David Mahon	1 lecture
Frontiers: *Light Sheet Microscopy*	Dr Chas Nelson	1 lecture
SEMESTER 2		
Quantum Phenomena I	Dr Fiona Speirits	8 lectures (incl. 1 tutorial)
Quantum Phenomena II	Dr Richard Bowman	8 lectures (incl. 1 tutorial)
Electricity, Electronics & Magnetism I	Dr Peter H. Sneddon	9 lectures (incl. 1 tutorial)
Electricity, Electronics & Magnetism II	Dr Caroline Muellenbroich	9 lectures (incl. 1 tutorial)
Thermal Physics II	Dr Richard Bates	8 lectures (incl. 1 tutorial)
Frontiers: *The Quandary of the Quark*	Prof. Christine Davies	1 lecture
Frontiers*: Gravitational Waves*	Prof Giles Hammond	1 lecture

3.2.2 Physics 1 labs

The laboratory sessions in P1 integrate problem-solving of tutorial questions with related experiments. The goal is that the questions and the experiments reinforce the work you cover in your lecture courses. They will also teach you practical skills, key to your success as a science-student. These sessions will also give you an opportunity to discuss other points arising from your study and will help staff to learn what you are finding difficult or obscure in the lecture courses.

Each lab session is supervised by five demonstrators, who are usually research assistants or PhD students. In addition there will be at least one member of the academic staff during any lab session. **It is essential that you attend and play an active part in the discussions in the laboratory and in the experimental work.**

The laboratory classes will begin in Week 5 of Semester 1, preceded by a three week teamwork exercise. More details on this can be found later in this document.

Laboratory performance is assessed and the lab work will contribute 25 % of your total mark for P1.

3.2.3 Peer to peer tutorials

During semester 1 and 2 there are a series of Peer to Peer (P2P) tutorials. In these sessions, students in the honours years of their degrees – levels 4/5 – act as student-tutors. They will be there to provide guidance and advice on questions set during the tutorials. The questions you attempt during these P2P to Peer tutorials will not contribute to your overall grade for the course, but they are an excellent opportunity to improve your physics skills and understanding with the assistance of your undergraduate peers. Your tutors were in your shoes not so long ago – they understand all too well what it's like to be a first year physics student. These sessions will give you the chance to make use of their experience, both relating to the physics you are learning and the wider world of being a student in the School of Physics and Astronomy at the University of Glasgow.

4 Assessment

Throughout the Physics 1 course there will be *summative* and *formative* assessment. Summative assessment is the term used to describe work that counts towards the final course grade; formative assessment refers to work that is offered to provide revision and feedback opportunities but does NOT count towards the overall course grade.

4.1 Summative assessment

The final grade you receive for this course will be on the University's 22-point scale. This scale grades student work from A (Excellent) through to G (Very Poor) or H (no attempt). Within each band there are subdivisions; the table below shows these broad bands, the sub-bands, and the primary verbal descriptors that explain what they mean.

SCHEDULE A

All Courses				Primary verbal descriptors for attainment of Intended Learning Outcomes	Honours Class	BDS, BVMS, MBChB
Primary Grade	Gloss	Secondary Band*	Aggregation Score			
A	Excellent	A1 A2 A3 A4 A5	22 21 20 19 18	Exemplary range and depth of attainment of intended learning outcomes, secured by discriminating command of a comprehensive range of relevant materials and analyses, and by deployment of considered judgement relating to key issues, concepts and procedures	First	Honours
B	Very Good	B1 B2 B3	17 16 15	Conclusive attainment of virtually all intended learning outcomes, clearly grounded on a close familiarity with a wide range of supporting evidence, constructively utilised to reveal appreciable depth of understanding	Upper Second	Commendation
C	Good	C1 C2 C3	14 13 12	Clear attainment of most of the intended learning outcomes, some more securely grasped than others, resting on a circumscribed range of evidence and displaying a variable depth of understanding	Lower Second	Pass
D	Satis-factory†	D1 D2 D3	11 10 9	Acceptable attainment of intended learning outcomes, displaying a qualified familiarity with a minimally sufficient range of relevant materials, and a grasp of the analytical issues and concepts which is generally reasonable, albeit insecure	Third	
E	Weak	E1 E2 E3	8 7 6	Attainment deficient in respect of specific intended learning outcomes, with mixed evidence as to the depth of knowledge and weak deployment of arguments or deficient manipulations	Fail	Fail
F	Poor	F1 F2 F3	5 4 3	Attainment of intended learning outcomes appreciably deficient in critical respects, lacking secure basis in relevant factual and analytical dimensions		
G	Very Poor	G1 G2	2 1	Attainment of intended learning outcomes markedly deficient in respect of nearly all intended learning outcomes, with irrelevant use of materials and incomplete and flawed explanation		
H			0	No convincing evidence of attainment of intended learning outcomes, such treatment of the subject as is in evidence being directionless and fragmentary		

CR	CREDIT REFUSED	Failure to comply, in the absence of good cause, with the published requirements of the course or programme; and/or a serious breach of regulations

* The Secondary Band indicates the degree to which the work possesses the quality of the corresponding descriptor.

† This gloss is used because it is the lowest grade normally associated with the attainment of an undergraduate award. Postgraduate students should be aware, however, that an average of at least Grade C in taught courses is required for progress to the dissertation at masters level, and students should consult the appropriate degree regulations and course handbooks for the grade they may require to progress to specific awards.

The summative assessment for the course will consist of 5 components, each of which will be ultimately graded on this 22-point scale. Those components are then weighted – as shown below – then added together to determine the overall course grade, also on the 22-point scale. The components and weightings are as follows:

- Two exam papers (50 %)
- One class test (10 %)
- Four check point quizzes (10 %)
- One Communication Project (5 %)
- Labs (25 %)

Component	Weighting	Detail
Degree Exams	2 x 25 %	▪ In person ▪ Each 90-minute paper will consist of five 10-mark questions. Paper 1 will focus on the modules running in Semester 1; Paper 2 will focus on the modules running in Semester 2. ▪ Students taking PHYS1001 tackle all questions in both papers.

		▪ Students taking PHYS1002 tackle all questions in Paper 1 only. ▪ Both Papers run in the April/May exam diet.
Class Test	10 %	▪ In person. ▪ This 60-minute test will consist of five 10-mark questions in exactly the same style as those that will be in the Degree Examinations. However, for the test, students will tackle 3 of those five questions. ▪ This test will run during the December exam diet.
Check Point Quizzes	4 x 2.5 %	▪ On-line through Moodle ▪ Set to run on the Fridays of Weeks 5 and 10 in each Semester. Students will have one hour to complete each test from the moment they access the test. ▪ Each will consist of 15 marks, combining MCQ-style and numerical-calculation questions drawn from the course modules running at the time of each quiz.
Physics Communication Project	5 %	▪ Physics Communication Project – a teamwork exercise ▪ Runs in Weeks 2, 3 and 4 of Semester 1. Details of this will be released through Moodle in Week 1 of Semester 1.
Labs	25 %	▪ See Lab Guide for details.

As an example, if a student achieved a grade of B1 (= 17) for the exams, C1 (=14) for the class test, A5 (= 18) for the check point tests, B2 (= 16) for the communication project and then A3 (= 20) for the labs, their overall course grade would be calculated as follows …

$$(0.5 \times 17) + (0.1 \times 14) + (0.1 \times 18) + (0.05 \times 16) + (0.25 \times 20)$$

$$= 8.5 + 1.4 + 1.8 + 0.8 + 5.0 = 17.5$$

This would be rounded to 18, and so the student would receive a grade of A5 for Physics 1.

For reference, admission to Physics 2 requires a grade of D3 (or 9) in Physics 1, plus the same grade in Maths 1.

4.1.1 Resit examinations

Students absent for medical or other good cause, or awarded grade E1 or lower (except grade CR) in the April/May examinations, will have an opportunity to resit the degree examination papers in August. Except in the case of medically certificated illness etc, the resit result will normally be capped at D3 (though your actual assessed grade will be available for reference), in accordance with College of Science and Engineering regulations. The resit examinations will be held in the University of Glasgow, unless special arrangements have been made with the Registrar beforehand, with the approval of the Senate Office, for resit examinations to be held overseas; in such cases any additional administrative costs will be at the student's expense.

Students should note that an opportunity for re-assessment will be provided only for the degree examination paper papers 1 and 2 for Physics 1. For all other assessment components of Physics 1 there will be no re-assessment opportunity available, due to the impracticality of such provision. This policy has been adopted with the approval of the Head of School and following the recommendation of the Physics and Astronomy Learning and Teaching Committee.

4.1.2 Degree examination procedures

All examination papers, together with detailed solutions and marking schemes, are assessed and verified both internally and by an External Examiner (from another university).

Each set of papers has a team of markers, so that the papers of a given candidate may be marked by up to six markers. All markers are familiar with the material they are examining. Markers work to the detailed solution, with allocation of marks to parts of the question previously agreed. The Class Head re-checks that all material has been marked and also checks the summations in the papers. Marks are then entered on a list of candidates and a final check made.

A committee of internal examiners and the External Examiner is responsible for final decisions. Scripts and the laboratory work of all candidates who took the examination are available to the External Examiner. At the Examiners' Meeting borderline cases are identified. Scripts around the borderline region are re-examined and boundary decisions (grades A1 to H) are made for individual students. In cases where the examiners are not agreed, the External Examiner (who has no first-hand knowledge of candidates) has the final decision. In general, however, grading decisions are taken by the Committee and not by an individual.

It is at the Examiners' Meeting that special circumstances and medical certificates are considered.

4.1.3 Plagiarism

In Physics 1, part of the assessment comes from laboratory work as already outlined. It is not our intention to stop you discussing laboratory results with others in your class. Such discussions can be very useful in increasing your understanding of the subject. In the case of the laboratory work you can expect to work in small groups, and we encourage you to collaborate and share information freely. However, your notes of the practical session, which are handed in and which will be assessed, should be an independent record of the afternoon's events and results.

The University definition of plagiarism is: “The incorporation of material without formal and proper acknowledgement (even with no deliberate intent to cheat) can constitute plagiarism. Work may be considered to be plagiarised if it consists of: a direct quotation; a close paraphrase; an unacknowledged summary of a source; direct copying or transcription”.

All students must familiarise themselves with the advice presented at https://www.gla.ac.uk/myglasgow/leads/students/plagiarism/.

4.1.4 Formative assessment

The formative assessment for the course will consist of 5 components:

- 10 Revision Exercises
- One example Class Test (for Semester 2 modules)
- Peer to Peer Tutorials
- Full class tutorials
- Mastering Physics

Component	Frequency	Detail
Revision Exercises	5 per Semester	▪ Released at the end of Wks 2, 4, 6, 8 and 10 of each Semester. ▪ 3 questions per Exercise, one from each of the lecture courses running at the time ▪ Questions will be chosen from textbook by lecturers ▪ The REs will formatted to look like exam-style questions ▪ Solutions will be released at the end of Wks 3, 5, 7, 9 and 11 of each Semester. These will be detailed in the style of the exam solutions to give you an idea of what we look for when assessing the exams.
Class Test	1 – end of Semester 2	▪ This will be in the style of the first class test, but focussing on the Semester 2 modules. The timetable does not permit us to run this summatively, but it will allow you to see what Semester 2 course questions look like. ▪ Full solutions will be made available three weeks after the test.
Peer to Peer Tutorials	4 per semester	▪ These tutorials are run by senior undergraduates and there will be dedicated question sheets provided that will tackle both course content and problem-solving skills.
Full Class Tutorials	1 per module; 10 in total	▪ Each P1 lecture module will have one dedicated tutorial that will help your revision of the course material. Details of these will be released by the individual lecturers nearer the time.
Mastering Physics	TBD	▪ Additional revision questions will be made available through the Mastering Physics package that accompanies the course

	textbook. Full details on these will be released through Moodle as the year progresses.

4.2 Course Materials

The textbook for the Physics 1 course is: "University Physics" 15th edition with Modern Physics – H D Young and R A Freedman, (Addison-Wesley). **The textbook is essential reading and purchasing it is strongly recommended for any student on a physics degree.** (Additional reading may be advised by lecturers). The lecture notes you are provided will cover all of the course content, though, so if you choose not to purchase the book you will still be able to fully engage with the course.

[Earlier editions of the book do not differ much in content from the earlier editions, except that page numbers and problem numbers differ, so you could use those - with care. Only the current edition – purchased from the University Book Shop – will come with access to Mastering Physics though.]

4.3 Minimum requirements to avoid CR

There are 3 requirements for award of grade letter H or better, all of which must normally be met.

1. Attendance at both the exam papers at the first (or second) examination diet.
2. Attendance at a minimum 50 % of the laboratory sessions, participation in the related tutorial exercises, and submission of the lab and tutorial work for marking. Level of submission required will be detailed in the lab manual.
3. Completion of at least 2 of the 4 check point quizzes.

Students are also encouraged to attempt at least 50 % of the *Mastering Physics* question sets.

Students who do not meet the above requirements (except due to certified illness or other acceptable cause) will normally be awarded grade CR, Credit Refused, and will not be awarded any credits for the course. Such a result would debar you from continuing towards a Physics degree.

You should be aware that missing an assessed session (laboratory or test) results in a score of 0 for that piece of work unless you produce a medical certificate or self certificate providing a valid reason why could not attend. So if you only attend half of

the labs/tests you can only obtain a maximum of 50 % of the total marks for these lab/tests.

5 Attendance and Adverse Circumstances

Students are expected to attend all lectures, tutorial and laboratory sessions. Attendance will be monitored. These attendance records will form part of the performance assessment. Attendance at the degree examinations is also compulsory.

If you miss an assessed session – exam, workshop test or lab – or if you believe your assessment performance has been affected by adverse circumstances, you must inform the classhead as soon as possible. You should also submit a **Good Cause Claim**, and this must be via MyCampus.

Submission of a Good Cause Claim is the mechanism that allows your circumstances to be considered by the Board of Examiners. Please note all Good Cause Claims must be submitted within **one week** of the date of the affected assessment.

Students should note that the University's Code of Assessment allows grades to be awarded only on the basis of demonstrated work. So, if you feel that some piece of assessed work has been affected by adverse circumstances, and if staff agree, then the only course of action available is for the grade for that piece of work to be set aside (in the case of continuously assessed work and Class Tests) or to allow a resit (in the case of Degree Exams) – marks cannot be adjusted.

To submit a Good Cause Claim on MyCampus:

1. Go to the 'Student Centre' and select *My Good Cause* from the Academics menu.

2. Select the relevant course(s).

3. Complete the report in MyCampus (there is provision for particularly sensitive information to be provided separately, outwith the system, but a claim report must still be entered into MyCampus).

4. Add supporting evidence by uploading documents. (Scanners are available on level 3 of the University Library.) It is the responsibility of the student to keep all original documentation and submit it to the Class Head on request.

If you encounter any difficulties with this process please contact the Class Head immediately to let him or her know you have a problem with your Good Cause Claim.

What will happen to your Good Cause Claim

The Course Administrator and/or Class Head will ensure that your claim is considered and this will be in accordance with the section of the Code of Assessment that covers incomplete assessment and good cause (paragraphs 16.45 to 16.53). The outcome of your claim will be posted into the Approval Information section on your Good Cause Claim in MyCampus. If it is accepted that your assessment was affected by good cause, the work in question will be set aside and you will (as far as is practicable) be given another opportunity to take the assessment with the affected attempt discounted.

For absences that are significant but for which a good cause claim is not being filed, students must complete a **MyCampus absence report**. A significant absence is defined to be:

- an absence of **more than seven consecutive days** during working periods
- an absence of **any duration** if it prevents a student from for example fulfilling any minimum requirement for the award of credit (e.g. missing attendance at one day of a two-day laboratory, but where the work was nonetheless submitted and therefore not involving a Good Cause claim).

All potentially significant absences should be reported as soon as is practical, by completing part 1 of the MyCampus absence report. Part 2 of the MyCampus absence report should be completed on return to university. The normal submission deadline for the completed absence report is 7 days after return to university. Documentary evidence is required when reporting any significant absence.

See also the Senate Office Absence Policy:
http://www.gla.ac.uk/services/senateoffice/policies/studentsupport/absencepolicy/

6 Course Component Details

6.1 Optics, Wave & Lasers (OWL)

6.1.1 General Aims of the Course

- To serve as an introduction to the various aspects of optics, and to provide a good basic understanding of geometric optics and physical optics.
- To introduce the fundamental ideas of wave theory, developed both in physical optics and in the behaviour of waves in gases and on strings.
- To gain an appreciation of the various aspects of physics involved in lasers, including optics, waves and atomic physics, and to learn about some of the many applications of lasers.
- To be able to solve simple problems relating to current applications involving waves and optics.

6.1.2 Objectives (Part 1)

1. Introduction

to discuss the ideas of the nature of light, and the different areas of study, namely geometrical, physical and quantum optics.

2. Geometrical Optics

i) to understand reflection from plane and from spherical surfaces, and to be able to evaluate the position and nature of images produced by reflection;
ii) to understand refraction of light and be able to apply the law of refraction at plane and spherical surfaces;
iii) to understand and be able to evaluate image formation by thin lenses, and to understand the limitations of thin lenses;
iv) to apply the principles of image formation by thin lenses to understand the optical construction of instruments, (including some but not all of the following: the camera, simple magnifier, compound microscope and astronomical telescope);
v) to solve problems involving mirrors and lenses.

6.1.3 Objectives (Part 2)

3. Introduction to Wave Theory

i) to understand the characteristics of wave motion, in particular sinusoidal waves and simple harmonic motion, and to understand the mathematical description of such waves;

ii) to appreciate the importance of simple harmonic motion in a wide diversity of physical situations;
iii) to understand the principle of linear superposition for waves and what is meant by constructive and destructive interference, and coherence;
iv) to solve simple problems on travelling waves.

4. Interference and Diffraction of Light

i) to recognise the observed phenomena of interference and diffraction;
ii) to understand Huygen's principle and its application to both geometrical and physical optics;
iii) to understand interference, in particular Young's double slit experiment and in thin films including Newton's rings experiment;
iv) to appreciate the application of the theory of interference in such areas as non-reflective and highly reflective coatings;
v) to understand the limitation to resolving power of lenses due to diffraction;
vi) to solve simple problems involving interference and diffraction phenomena.

5. Lasers

i) to understand what is meant by coherent and incoherent light sources;
ii) to understand the terms spontaneous and stimulated emission and population inversion and to be able to describe the requirements for laser action;
iii) to understand the operation of simple 3 and 4 level lasers;
iv) to be able to describe the main properties of some commonly used lasers, and some of their many applications such as in precision measurement, medical physics and optical communications;
v) to understand the Doppler effect.

Examples of application areas

1. Reflection - retro-reflectors; refraction and total internal reflection - optical fibres in communication and medicine, binoculars, mirages, rainbows; lenses - optical instruments, zoom lens, Fresnel lens; lens and mirror - cat's eyes; lens aberrations - use of mirrors in large telescopes.
2. Simple harmonic motion - Fourier analysis, examples of SHM (earth vibrations, quartz crystals, sound waves from musical instruments).
3. Interference - coloured fringes in oil films, non-reflective coatings, ultra-high reflectivity mirrors; diffraction effects - resolution of telescopes.
4. Dispersion by a prism.

5. Accurate distance measurements, bar code readers, cd players, medical applications, precision drilling and cutting, optical communications, holography.

OWL Textbook references & approximate lecture breakdown (14 + 2 tutorials)

		Young & Freedman 14th edition	*Lectures (approx)*
1	**Introduction**		
	Nature of light		
	Geometrical, physical and quantum optics	32.1, 33.1	1
2	**Geometrical Optics**	33.1	
	Reflection at plane and spherical surfaces		
	Mirror equation and graphical methods for images	33.2, 34.1-3	
	Refraction at plane and spherical surfaces, dispersion	33.2-4, 34.3	
	Converging and diverging lenses, thin lens and lens-maker's equation and graphical methods for lenses	34.4	
	Camera, simple magnifier, compound microscope, astronomical telescope	34.5, 34.7-8	6
3	**Introduction to Wave Theory**		
	Characteristics of wave motion		
	Mathematical description of waves	15.1-3	
	Simple harmonic motion	14.1-4	
	Principle of superposition, constructive and destructive	15.6	
	interference and coherence	35.1	2
4	**Interference and Diffraction of Light**		
	Physical optics - wave behaviour of light	35.1-2, 36.1	
	Huygen's principle	33.7	
	Young's slit experiment	35.2-3	
	Thin films, Newton's rings	35.4	2
5	**Lasers and their Applications**		
	Coherent and incoherent light sources	35.1	
	Spontaneous and stimulated emission and population inversion	39.4	
	Requirements for lasing action		
	3 and 4 level lasers		
	Applications	39.4, 36.8	
	Doppler effect	16.8, 37.6	3

6.2 Dynamics & Relativity (D&R)

6.2.1 General Aims of the Course

- To discuss laws pertaining to objects in motion and study the basic principles of the special theory of relativity.
- To develop good understanding of linear, circular and periodic motion for point particles.
- To introduce ideas relating to conservation of energy, linear and angular momentum.
- To be able to solve simple problems relating to current applications of dynamics and relativity.

6.2.2 Objectives (Part 1)

1. Motion in One Dimension

   i) to understand uniformly accelerated motion in one dimension;
   ii) to use the equations of motion $v = v_0 + at$, $x = v_0 t + \frac{1}{2}at^2$, $v^2 = v_0^2 + 2ax$ to solve problems involving one dimensional motion;
   iii) to understand the vector nature of velocity and acceleration;
   iv) to define and understand relative velocity and acceleration in one dimension and solve problems using these ideas.

2. Uniform Circular Motion

   i) to understand the motion of a particle travelling with uniform speed in a circle;
   ii) to be able to define angular displacement, angular speed, radian, tangential speed, angular acceleration and use these terms correctly to derive the relationships $\vec{v} = \omega\vec{r}$ and $a_r = \frac{v^2}{r}$;
   iii) to be able to apply the above to the motion of satellites and other rotating bodies.

3. Newton's Laws of Motion

   i) to understand Newton's laws of motion, the concept of force and the concept of Newtonian gravity;
   ii) to apply these to problems.

4. Simple Harmonic Motion (SHM)

   i) to know the meaning of amplitude, period, frequency, angular frequency;
   ii) to understand the expressions for displacement, velocity and acceleration in SHM;

iii) to appreciate the range of physics situations described by SHM;
iv) to derive formulae for the period of a simple pendulum and a mass on a spring;
v) to obtain the equation for energy during SHM.

6.2.3 Objectives (Part 2)

5. Work and Kinetic Energy
   i) to understand the concepts of work and kinetic energy;
   ii) to understand Hooke's law and restoring force;
   iii) to understand work done by a varying force and apply it to the calculation of work done in stretching a spring;
   iv) to know the work-energy theorem and its application to practical situations;
   v) to understand that $P = \vec{F} \cdot \vec{v}$.
6. Conservation of Energy
   i) to understand the concept of potential energy;
   ii) to distinguish between conservative and non-conservative forces;
   iii) to know the relationship between force and potential energy;
   iv) to appreciate how energy can change from one form to another;
   v) to be able to solve problems involving energy transfer.
7. Linear Momentum and Collisions
   i) to define momentum;
   ii) to understand the conservation of linear momentum and be able to solve elastic and inelastic collision problems in simple situations.
8. Angular Momentum
   i) to know the definition of angular momentum of a particle about an axis;
   ii) to have a qualitative understanding of the role of angular momentum in rotational motion.
9. Special Theory of Relativity
   i) to appreciate that the ideas of special relativity are outside our everyday experience; consequently 'common sense' is not appropriate in dealing with problems in special relativity;
   ii) to understand inertial and rest frames of reference;
   iii) to know Einstein's two postulates, and the consequences for simultaneity;
   iv) to understand time dilation and space contraction and appreciate consequences of these for bodies moving with speeds comparable to the speed of light;
   v) to understand energy-momentum relation for relativistic particles.

Examples of application areas:

1. Motion of bodies experiencing uniform acceleration, e.g. freely falling bodies, cars, trains, etc., observations by a stationary observer of events in a moving frame.

2. Satellite motion, rotating space stations, carnival ride.
3. Skiing, rocket propulsion.
4. Spring scale, swing, pile-driver.
5. Sky diver, skateboarding, roller-coaster.
6. Grandfather clock, human leg as a pendulum, molecular vibrations.
7. Snooker, collisions in ice-skating, cars colliding, scattering processes in nuclear and particle physics.
8. Twin paradox, change of mass with kinetic energy, $E = mc^2$, energy needed to produce new particles, collisions between high energy particles.

D&R Textbook references & approximate lecture breakdown (16 + 2 tutorials)

		Young & Freedman 14th edition	*Lectures*
1	**Motion in One and Two Dimensions**		
	Equations of motion (uniform acceleration)	2.4-6	
	Velocity and acceleration vectors	3.1-2	
	Projectile motion in 2-D	3.3	
	Relative velocity	3.5	2
2	**Uniform Circular Motion**	3.4	1
3	**Newton's Laws of motion**		
	Force	4.1	
	Statement of Newton's laws of motion, mass and weight	4.2-5	
	Applications to problems, including friction & circular motion	[chapter 5]	3
4	**Simple Harmonic Motion**	14.1-2, 14.5	2
5	**Work and Kinetic Energy**		
	Work, $W = \vec{F} \cdot \vec{x}$	6.1	
	Work and kinetic energy (work-energy theorem)	6.2	
	Work done by a varying force	6.3	
	Power, $P = \vec{F} \cdot \vec{v}$	6.4	1
6	**Conservation of Energy**		
	Potential energy	7.1-2	
	Conservative and non-conservative forces	7.3	
	Force and potential energy $\vec{F} = -\frac{dU}{d\vec{x}}$	7.4	1
7	**Linear Momentum and Collisions**		
	Linear momentum $\vec{p}$, conservation of $\vec{p}$	8.1-2	
	Elastic and inelastic collisions	8.3-4	1.5
8	**Angular Momentum**		
	Angular momentum of a point particle	10.5 (part)	0.5
	Its analogous role to linear momentum.		
9	**Special Theory of Relativity**		
	Invariance of physical laws	37.1	
	Relative nature of simultaneity	37.2	
	Relativity of time	37.3	
	Relativity of length	37.4	
	Energy momentum relation	37.8	4

6.3 Thermal Physics (TP)

6.3.1 General Aims of the Course:

- To understand temperature, heat transfer, and thermal properties of solids, liquids and gases.
- To understand the relationship between temperature and kinetic energy of molecules for ideal gases and appreciate the differences between ideal and real gas behaviour.

6.3.2 Objectives

1. Temperature and Heat

i) to understand the concept of temperature, and how temperature scales are constructed;
ii) to understand the requirements of different types of thermometers in, for example, industrial and medical applications;
iii) to understand thermal expansion of liquids and solids;
iv) to understand what is meant by specific and molar heats of capacity;
v) to know about the Law of Dulong and Petit;
vi) to understand phases changes and latent heat;
vii) to be able to apply the principle of conservation of energy to calorimetry.

2. Mechanisms of Heat Transfer

i) to study the transfer of heat energy by conduction and be able to apply the theory in simple situations;
ii) to understand convection processes;
iii) to understand heat transfer by electromagnetic radiation, know the Stefan-Boltzmann Law and understand what is meant by a black body;
iv) to be able to apply the above ideas to understand various heat transfer situations such as thermal insulation and heat loss from bodies.

3. Ideal and Real Gases

i) to understand what is meant by an equation of state;
ii) to examine the behaviour of the ideal gas as encompassed in the ideal gas law;
iii) to contrast this with the behaviour of real gases and understand that the ideal gas law needs to be modified under certain conditions of temperature and pressure as, for example, in the Van der Waals equation;

iv) to understand and be able to interpret pV and phase diagrams.

Examples of application areas

1. Need for different kinds of thermometer (industrial, medical, etc); expansion joints in bridges.
2. Heat sinks for ICs; double glazing; insulation; thermal boxes; sea breezes; sunbathing.

TP Textbook references & approximate lecture breakdown (7 + 1 tutorial)

		Young & Freedman 14^{th} edition	*Lectures (approx)*
1	**Temperature and Heat**		
	Temperature and thermal equilibrium		
	Zeroth law of thermodynamics		
	Thermometric properties	17.1-3	
	Thermal expansion of liquids and solids	17.4	
	Specific Heat Capacity		
	Calorimetry and Phase Changes	17.5-6	3
2	**Mechanisms of Heat Transfer**		
	Conduction		
	Convection	17.7	
	Radiation, Stefan-Boltzmann law, black body		2
3	**Ideal and Real Gases**		
	Equations of state; ideal gas equation		
	Van der Waals equation	18.1-2	
	pV diagrams, phases of matter		2

6.4 Electricity, Electronics & Magnetism (EEM)

6.4.1 General Aims of the Course

- To convey the importance of electromagnetism in physics and modern technology.
- To introduce the basic principles of electrostatics, current electricity, the operational amplifier, and magnetism.
- To illustrate these principles using examples from modern technology and to be able to solve problems in these areas.

6.4.2 Objectives (Part 1)

1. Introduction

   to stress the importance of electromagnetism as one of the four fundamental forces of nature and its importance in modern technology.

2. Electrostatics

   i) to understand the concept of charge, Coulomb's Law of Force and the concepts of electric field and electric potential and be able to evaluate the force, electric field and electric potential for a set of point charges;

   ii) to know the relationship between potential gradient and electric field to tackle simple problems in electrostatics.

3. Magnetism

   i) to understand the concepts of magnetic field and magnetic flux;

   ii) to know the motion of charged particles in uniform magnetic fields and combined electric and magnetic fields and applications;

   iii) to know the magnetic force on a conductor and torque on current loop;

   iv) to understand Ampere's law and know how to apply it;

   v) to tackle simple problems in magnetism.

6.4.3 Objectives (Part 2)

4. Current Electricity and Electronics

   i) to understand the concepts of current, resistivity, resistance, sources of emf and internal resistance, electrical power in DC circuits;

   ii) to be able to apply Ohm's law and prove the 'Maximum power theorem';

   iii) to know and be able to apply Kirchhoff's rules to simple DC circuits;

   iv) to understand the concepts of gain, input and output resistance of amplifiers;

   v) to understand the properties of an (ideal) Op Amp and the principles of operation of simple Op Amp circuits.

Examples of application areas

1. General importance in modern technology, telecommunication, power generation and transmission, modern electronics etc. (as well as being one of the fundamental forces of nature - atoms, chemical bonding etc.).
2. Xerography, inkjet printer, electrostatic screening, lightning conductor, field emission/ion microscope, electrostatic precipitator, geiger counter, Van de Graaff, cathode ray tube.
3. Electric light, household electric circuit, resistance (spot-) welding, audio amplifier, high impedance voltmeter, analogue computer.
4. Magnetic bottle (Van Allen radiation belts and aurora), mass spectrometry, Hall probe, particle accelerators (cyclotron, synchrotron), electron microscope, electric motor, loudspeaker, moving coil meter.

TP Textbook references & approximate lecture breakdown (16 + 2 tutorials)

		Young & Freedman 14th edition	*Lectures*
1	**Introduction**		
	Forces of nature etc.	44.3, 44.1	
2	**Electrostatics**		
	Electric charge		
	Conductors and insulators		
	Conservation and quantisation	21.1-6	
	Coulomb's Law (point charges only)		
	Units		
	Electric field, $\underline{E}$, field lines		
	(point charges only)		
	Charges on conductors	22.5 (part)	
	Electric potential energy		
	(Electric) potential, V		
	(point charges only)	23.1-5	
	Potential gradient and $\underline{E}$		
	Equipotentials		4
3	**Magnetism**		
	Introduction, magnetic field		
	Magnetic field lines and magnetic flux		
	Motion of charged particles in uniform	27.1-9	
	magnetic field and combined magnetic		
	and electric fields		
	Applications		
	Magnetic force on conductor		
	Force and torque on current loop		
	Ampere's Law and applications	28.6-7	4
4	**Current Electricity and Electronics**		
	Current, resistivity and Ohm's law		
	Resistance	25.1-5	
	DC sources - emf and internal resistance		
	Power in DC circuits - maximum power		
	theorem		
	DC circuits, resistors in series, parallel		
	Kirchhoff's rules and applications	26.1-3	4
	Amplifiers, input and output impedance,		
	gain		
	Operational amplifiers - properties	notes and labsheets	
	Feedback, inverting amplifier, signal		

addition, non-inverting amp	4

6.5 Quantum Phenomena (QP)

6.5.1 General Aims of the Course

- To introduce the students to a wide range of quantum phenomena and discuss some of the concepts which are necessary to understand and interpret the phenomena.
- To provide a foundation for the understanding of the properties of single atoms.
- To appreciate wave-particle duality.
- To provide an introduction to particle physics and cosmology and to see how insight can be gained into the nature of the universe and the beginning of time.
- To carry out simple calculations relating to the scale of different quantum phenomena and to solve simple problems in atomic and nuclear physics.

6.5.2 Objectives (Part 1)

1. Rutherford Model of the atom

   i) to discuss the basic properties of atoms, size, mass etc.;
   ii) to describe the Rutherford nuclear model and its verification through Rutherford scattering experiments.

2. Particle Properties of Electromagnetic Radiation

   i) to describe the intensity distribution as a function of wavelength for radiation from a black body, including Stefan's Law and Wien's Law; to compare the distribution to the Rayleigh-Jeans (classical) formula and the Planck distribution including the concept of the photon;
   ii) to describe the photo-electric effect and contrast the expectations from classical theory with those from quantum theory and the experimental results; to discuss applications such as solar cells and photodiodes;
   iii) to discuss the concept of linear momentum for the photon and how this leads to Compton scattering.

3. Wave-like Properties of Particles

   i) to calculate the wavelengths of particles using de Broglie's formula;
   ii) to describe particle (electron) interference and diffraction and its application in the transmission electron microscope;
   iii) to discuss the Heisenberg Uncertainty Principle motivated from the idea of combining several waves of different wavelength into a wave packet.

4. Wave Mechanics of Particles

i) to consider the example of a particle confined to a box and the solutions for the wave function from Schrödinger's equation;
ii) to discuss how conditions of 'reasonableness' on the wave function, y, lead to a quantisation condition on the energy of the particle, and a minimum (non-zero) energy;
iii) to discuss how the concept of particle position is now replaced with one of probability for the particle to be in a particular place;
iv) to discuss tunnelling and its application to the scanning tunnelling microscope.

5. Quantum Theory of the Atom

i) to discuss how the observation of atomic line spectra lead to the idea of energy levels for electrons inside atoms;
ii) to describe how the solutions of Schrödinger's equation for the hydrogen atom give binding energies proportional to $1/n^2$ from the quantisation condition;
iii) to describe line spectra as the emission or absorption of photons by electrons to jump energy levels;
iv) to discuss ionisation.

6.5.3 Objectives (Part 2)

6. Atomic Structure

i) to discuss the quantisation of angular momentum and quantum numbers;
ii) to discuss the concept of electron intrinsic spin;
iii) to introduce the Pauli exclusion principle;
iv) to discuss many electron atoms and the Periodic Table.

7. Particle Physics and Cosmology

i) to develop the idea of particles as force mediators;
ii) to present a summary of the elementary particles and their interactions;
iii) to introduce the idea of quarks;
iv) to discuss the desirability of finding a unified description of the forces of nature;
v) to present the concept of an expanding universe;
vi) to introduce ideas about the beginning of time.

Examples of applications areas

1. Fluorescence, luminescence, sodium and mercury street lighting
2. Photoelectric cells, solar cells, photomultipliers, greenhouse effect
3. Electron microscope
4. Technologies associated with accelerator development, for example, R.F. engineering, vacuum technology, cryogenics etc.

QP Textbook references & approximate lecture breakdown (14 + 2 tutorials)

		Young & Freedman 14th edition	*Lectures (approx)*
1	**Rutherford-Bohr Model of the Atom**	39.2	1
2	**Particle Properties of Electromagnetic Radiation**		
	Blackbody radiation	39.5	
	Photoelectric effect	38.1	
	Compton scattering	38.2, 38.3	3
3	**Wave Properties of Particles**		
	de Broglie's hypothesis	39.1	
	Electron diffraction	39.1	
	Heisenberg uncertainty principle	38.4	2
4	**Wave Mechanics**		
	Schrodinger’s equation	40.1	
5	**Quantum Theory of the Atom**		
	Line spectra	39.2, 39.3	1
6	**Atomic Structure**		
	The hydrogen atom		
	Angular momentum quantum number	41.3	
	Electron spin	41.5	
	Exclusion principle	41.6	
	Many electron atoms & periodic table	41.6	4
7	**Particle Physics and Cosmology**		
	Particles as force mediators	Chapter 44	
	Particles and interactions		
	Quarks		
	Unified theories		
	The expanding universe		
	The beginning of time		3

6.6 Thermal Physics Part 2

6.6.1 General Aims of the Course

- In general, to serve as an introduction to some of the basic properties and behaviour of solids, liquids and gases.
- To understand the relationship between temperature and kinetic energy of molecules for ideal gases, and appreciate the differences between ideal gas behaviour and real gases.
- To study the basic ideas of hydrostatics and hydrodynamics.
- To consider the behaviour of matter under tensile, compressive and shear forces.
- To introduce some simple properties of solids, and gain an appreciation of the relation between structure, bonding and mechanical properties.
- To be able to solve simple problems in various application areas involving thermal and mechanical properties.

6.6.2 Objectives

1. Molecular Properties of Matter
   i) to develop the kinetic theory of an ideal gas and understand the assumptions used;
   ii) to establish the relationship between kinetic energy and temperature for an ideal gas, and know about molecular speeds;
   iii) to understand the concept of internal energy and to appreciate its magnitude.
2. Hydrostatics and Hydrodynamics
   i) to know what an incompressible fluid is;
   ii) to understand about pressure in a fluid, and how it varies with depth;
   iii) to be able to apply the ideas of hydrostatics to have a simple understanding of buoyancy;
   iv) to understand and use the equation of continuity for fluid flow;
   v) to derive Bernoulli's equation and be able to use it in simple calculations involving, for example, a domestic water supply;
   vi) to appreciate some of the differences in behaviour between ideal and real fluids.

3. Elasticity and Plasticity
   i) to understand about linear tensile stress and strain, to know and be able to apply Hooke's Law, and to know the definition of Young's modulus;
   ii) to know and understand about bulk stress and strain, bulk deformation and bulk modulus;

iii) to know and understand about shear stress and strain, sheer deformation and sheer modulus;
iv) to know about plastic deformation;
v) to be able to apply the ideas of stress and strain for example in suspension systems.

Examples of application areas

1. Gaseous diffusion of U.
2. Hydraulic lift; aeroplane wings; frisbees, top-spin, side-spin etc; domestic water supply.
3. Cantilever and arch bridges; suspension systems.
4. Ductile and brittle solids; molecular solids.

TMPM Textbook references & approximate lecture breakdown (7 + 1 tutorial)

		Young & Freedman 14th edition	*Lectures (approx)*
1	**Molecular Properties of Matter**		
	Avogadro's number		
	Kinetic theory of gases, kinetic energy, internal energy, equipartition of energy, molecular speeds	18.3-5	1.5
2	**Hydrostatics and Hydrodynamics**		
	Pressure in a fluid,	12.2	
	Bernoulli's equation	12.3-5	
	Introduction to real fluids		3
3	**Elasticity and Plasticity**		
	Tensile stress and strain, Hooke's law, elastic modulus		
	Bulk stress and strain	11.4	
	Shear stress and strain	11.4-5	
	Plastic deformation		2.5

7 Information for Exchange students

Physics 1 and Physics 1 (Half) can be taken by incoming international exchange students as part of an approved programme of study. Please consult the Physics & Astronomy International Student Coordinator for advice.

8 Adverse Circumstances

All absences from lectures, tutorials, laboratories, class tests and end of course examinations should be accounted for. You should comply with the University regulations for absence as stated on the Registry webpages. Regulations are set out in the following link for student absence policy http://www.gla.ac.uk/services/registry/students/absence/.

Absences from laboratories or workshop tests without submitted evidence of medical or other good cause will result in a lower mark, or even Credit Refused. It is your responsibility to ensure that absences are accounted for in accordance with the student absence policy.

9 Student societies

PhySoc and AstroSoc are student-run societies that arrange evening lectures and events during the year. Links to both of these groups are provided on the Physics 1 moodle site and students are encouraged to participate. There is also the opportunity to engage with the Glasgow Women in Physics group of our School, or the Justice, Equity, Diversity and Inclusion (JEDI) in Physics group.

10 Getting help and advice

If you need help about any aspect of the P1 class please **ASK**. If you have queries about a particular course it is best to first approach the lecturer concerned. If you have more general queries, or other difficulties or concerns, you should feel welcome to speak to the Class Head or the Laboratory Head. Tutors and demonstrators in the practical classes are also there to help you.

Information such as tutorial exercises, examination arrangements, changes to the timetable and other administrative details will be posted on the class Moodle site. It is your responsibility to look at this site regularly.

10.1 Student Support Officer

The School of Physics and Astronomy has a dedicated Student Support Officer - Mara Dougall (phas-studentsupport@glasgow.ac.uk) - here to help with any non-academic issues you might encounter over the course of your studies.

Student Support Officers provide a range of practical and emotional support. Mara can help you navigate things like:

- managing your health and wellbeing
- study skills
- financial issues
- accessing university services (such as counselling and disability services).

If you have a problem or question – or just need someone to talk to confidentially, you can think of your Student Support Officer as a friendly, accessible contact point within the School.

Please feel free to contact Mara directly with your enquiry, or to set up an in-person or online meeting.

10.2 Staff-student committee

This meets once per semester. You will have the chance to elect class representatives soon after the beginning of Semester 1. Please keep them informed of any matters concerning the Physics 1 course that you would like to have discussed at Staff-Student committee meetings. If, however, you have any comments, queries or suggestions on any aspect of the course, please do not hesitate to contact the Class Head or Laboratory Head at any time.

10.3 Support for those with disabilities

If you have a disability, please let the class head know in advance. Every possible measure will be taken to make sure that you can participate in all activities. There is level entry to the Kelvin Building, and lift access to the lecture theatre and laboratories. Should you have a disability or special needs in respect of course work or examinations, please inform one of the University's Disability Advisers: details can be found on the web at http://www.gla.ac.uk/services/disability.

Apart from the support provided via the Disability Service located at 65 Southpark Avenue, within the School, Prof Siong Heng (Room 252c; Ik.Heng@glasgow.ac.uk) is available to advise students with disabilities on matters relating to their participation in their coursework.

10.4 Information on Student Learning Service

The Learning Enhancement and Academic Development Service (LEADS) offers study skills advice, guidance and support to all students. If you would like to make your learning techniques more effective, you can attend workshops that take place regularly or contact the relevant Effective Learning Adviser. Popular topics for discussion include improving essay writing, revision techniques, exam techniques and note-making. You can find more information about the LEADS at https://www.gla.ac.uk/myglasgow/leads/students/.

10.5 University Services and Support

A range of support services are offered by the University and are listed at https://www.gla.ac.uk/myglasgow/students/supportservices/. These include health and mental wellbeing, Counselling and Psychological Services, Personal Development, and much more.

10.6 NUMBER: Student Mathematical Support

NUMBER: Student Mathematical Support offers support to all Level 1 students and to other undergraduates studying first year level mathematics and/or statistics. To make a one-to-one appointment with the Maths Adviser, email studentlearning@gla.ac.uk using your student email address.

Further information from this link: https://www.gla.ac.uk/myglasgow/leads/students/

10.7 Complaints procedure

Obviously, we hope that your time at university goes as smoothly as possible, but if you do have cause to raise a complaint about anything, the university has a clear policy for handling these.

Under the University Complaints Procedure, if you have a complaint please raise it with a member of staff in the area concerned. We aim to provide a response to the complaint within five working days. This is Stage 1.

If you are not satisfied with the response provided at Stage 1 you may take the complaint to Stage 2 of the procedure. Similarly, if your complaint is complex, you may choose to go straight to Stage 2. At this stage the University will undertake a detailed investigation of the complaint, aiming to provide a final response within 20 working days.

You can raise a Stage 2 complaint in the following ways:

- by e-mail: complaints@glasgow.ac.uk; by phone: 0141 330 2506
- by post: The Senate Office, The University of Glasgow, Glasgow, G12 8QQ
- in person: The Senate Office, Gilbert Scott Building, The University of Glasgow.

Complaints do not have to be made in writing but you are encouraged to submit the completed Complaint Form (available at http://www.gla.ac.uk/services/senateoffice/workingwithstudents/complaints/) whether it is at Stage 1 or Stage 2. This will help to clarify the nature of the complaint and the remedy that you are seeking.

Remember that the SRC Advice Centre is available to provide advice and assistance if you are considering making a complaint. (Tel: 0141 339 8541; e-mail: advice@src.gla.ac.uk).

APPENDIX: Skills

All of the degrees that the School of Physics & Astronomy offers are accredited by the Institute of Physics. If you wish to learn more about this process, you can find information at https://www.iop.org/education/support-work-higher-education/degree-accreditation-recognition#gref

Accreditation is based on 5 key principles …

Principle 1 Accredited degree programmes must meet the criteria detailed within the key expectations.

Principle 2 Accredited degree programmes should provide a positive and engaging experience of physics and encourage students to foster and maintain an intellectual curiosity in the discipline.

Principle 3 Universities and physics departments must have robust quality assurance and quality enhancement mechanisms in place and ensure that quality and standards are not compromised.

Principle 4 Universities and physics departments must have a clear commitment to equality, diversity and inclusion and this should be evident within the university and departmental culture, environment and physics curriculum.

Principle 5 Universities must ensure that physics departments are provided with adequate resources to support their accredited degree programmes, to enable the adoption of good teaching practice and to provide students and staff with a supportive environment.

In this Appendix we detail how PHYS1001 addresses Principle 1. The definition of skills for the purpose of IOP accreditation can be found at Subject Benchmark Statement: Physics, Astronomy and Astrophysics (qaa.ac.uk)[3], and the tables below use the numerical labels from the QAA. Not all skills are taught in every year/class, but by the end of your degree you will have had the opportunity to develop and demonstrate all of these.

[3] https://www.qaa.ac.uk/docs/qaa/subject-benchmark-statements/subject-benchmark-statement-physics-astronomy-and-astrophysics.pdf?sfvrsn=eff3c881_4

Subject-based skills, generic skills and attributes

3.9 Bachelor's and integrated master's degrees in physics provide the opportunity for students to acquire and demonstrate a wide range of competences in both subject-specific and generic skills, of which the following are particularly relevant.

Physics skills include the ability to …

3.10.i	Formulate and tackle problems in physics. E.g. students learn how to identify the appropriate physical principles, how and when to use special and limiting cases and order-of-magnitude estimates to guide their thinking about a problem and how to present the solution, making their assumptions and approximations explicit	
	Where this is addressed	Within lecture courses, lab classes and dedicated tutorials and assessments
	Formatively Assessed	Revision exercises, 2nd class test, peer to peer tutorials
	Summatively Assessed	4 Checkpoint quizzes, 1st class test, degree exams, lab classes
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.
3.10.ii	Use mathematics to describe the physical world. Students gain an appreciation of mathematical modelling, computing, and of the role of approximation.	
	Where this is addressed	Within lecture courses, lab classes and dedicated tutorials and assessments
	Formatively Assessed	Revision exercises, 2nd class test, peer to peer tutorials
	Summatively Assessed	4 Checkpoint quizzes, 1st class test, degree exams, lab classes
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.
3.10.iii	Plan, execute and report the results of an experiment or investigation	
	Where this is addressed	Within lab classes.
	Formatively Assessed	Demonstrator feedback in lab classes
	Summatively Assessed	Submitted lab exercises
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.
3.10.iv	Use appropriate methods to analyse data, to evaluate the level of its uncertainty and to take this into account in the development of work and to relate any conclusion made to current theories of the physics involved	
	Where this is addressed	Within lab classes.
	Formatively Assessed	Demonstrator feedback in lab classes
	Summatively Assessed	Submitted lab exercises
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.
3.10.v	Use appropriate software such as programming languages and purpose-written packages	
	Where this is addressed	Within lab classes.
	Formatively Assessed	Demonstrator feedback in lab classes
	Summatively Assessed	Submitted lab exercises
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.

3.10.vi	Compare critically the results of theoretical and computational modelling with those from experiment and observation.	
	Where this is addressed	Within lab classes.
	Formatively Assessed	Demonstrator feedback in lab classes
	Summatively Assessed	Submitted lab exercises
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.

Generic skills

3.11 Generic skills include:

3.11.i	Problem-solving skills - physics degree courses require students to solve problems with well-defined solutions. They also allow students to gain experience in tackling open-ended problems that may cross subject boundaries. Courses allow students to demonstrate their ability to formulate problems in precise terms and to identify key issues. They enable students to develop the confidence and creativity to try different approaches in order to make progress on challenging problems.	
	Where this is addressed	Well-defined problems: Within lecture courses and dedicated tutorials and assessments Open-ended problems: Within lab classes and assessments
	Formatively Assessed	Revision exercises, 2nd class test, peer to peer tutorials, demonstrator feedback in labs
	Summatively Assessed	4 Checkpoint quizzes, 1st class test, degree exams, lab classes
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.
3.11.ii	Investigative skills - physics degrees provide students with the opportunity to develop their skills of independent investigation. Students gain experience of using textbooks, and other available literature, of searching databases and the internet, and of interacting with colleagues to derive important information	
	Where this is addressed	Physics Communication Project and lab classes
	Formatively Assessed	Staff feedback on Physics Communication Project and demonstrator feedback in labs
	Summatively Assessed	Physics Communication Project and lab assessments
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.
3.11.iii	Communication skills - physics, and the mathematics used in physics, deal with surprising ideas and difficult concepts; good communication is essential. Physics degrees allow students to demonstrate their ability to listen carefully, to read demanding texts, and to present complex information in a clear and concise manner to a range of different audiences	
	Where this is addressed	Physics Communication Project
	Formatively Assessed	Staff feedback on Physics Communication Project
	Summatively Assessed	Physics Communication Project
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.
3.11.iv	Analytical skills - physics degrees help students learn the need to pay attention to detail and to demonstrate their ability to manipulate precise and intricate ideas, to construct logical arguments and to use technical language correctly	
	Where this is addressed	Physics Communication Project and lab classes

	Formatively Assessed	Staff feedback on Physics Communication Project and lab demonstrators
	Summatively Assessed	Physics Communication Project and lab assessments, including formal report.
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.
3.11.v	ICT skills - physics degrees provide the opportunity for students to acquire these skills in a variety of ways	
	Where this is addressed	Physics Communication Project and lab classes
	Formatively Assessed	Staff feedback on Physics Communication Project and lab demonstrators
	Summatively Assessed	Physics Communication Project and lab assessments, including formal report.
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.
3.11.vi	Personal skills - physics degrees allow students to demonstrate their ability to work both independently and in a group. Independently they are able to use their initiative, be organised and meet deadlines. In a group they are able to interact constructively as part of a team.	
	Where this is addressed	Independently – throughout all aspects of the course In groups – in the Physics Communication Project and lab classes
	Formatively Assessed	Staff and demonstrator feedback throughout course
	Summatively Assessed	Independently – throughout all aspects of the course In groups – in the Physics Communication Project and lab classes
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.

Professional behaviour

3.12 Physics degrees allow students to develop:

3.12.i	An appreciation that to fabricate, falsify or misrepresent data or to commit plagiarism constitutes unethical scientific behaviour. A professional physicist is objective, unbiased and truthful in all aspects of their work and recognises the limits of their knowledge	
	Where this is addressed	Physics Communication Project and lab classes
	Formatively Assessed	Staff feedback on Physics Communication Project and lab demonstrators
	Summatively Assessed	Physics Communication Project and lab assessments, including formal report.
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.
3.12.ii	The ability to identify the potential ethical issues in their work	
	Where this is addressed	Physics Communication Project and lab classes
	Formatively Assessed	Staff feedback on Physics Communication Project and lab demonstrators
	Summatively Assessed	Physics Communication Project and lab assessments, including formal report.
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.

3.12.iii	Where appropriate, an appreciation of intellectual property, environmental and sustainability issues	
	Where this is addressed	?
	Formatively Assessed	?
	Summatively Assessed	?
	How is this promoted to class?	?
3.12.iv	An understanding of what constitutes a safe working environment.	
	Where this is addressed	Lab classes
	Formatively Assessed	Feedback from lab demonstrators
	Summatively Assessed	NA
	How is this promoted to class?	Through in class announcements, Moodle announcements and via course documentation.