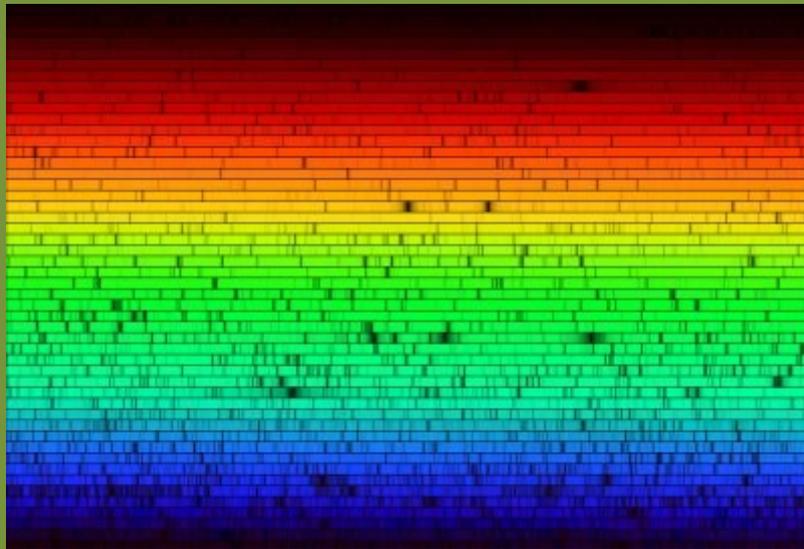




University  
of Glasgow | School of Physics  
& Astronomy



solar spectrum

# Astronomy 2

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*Course Information Guide 2023-24*

A 30 credit module, designed to be a link between the elementary astronomy of level 1 and a combined honours degree in Astronomy and Physics or Astronomy and Mathematics, or a single honours degree in Physics with Astrophysics

## Contents

1	Welcome statement from Head of School .....	<b>Error! Bookmark not defined.</b>
2	General Information and Introduction .....	2
3	Course Description.....	3
3.1	Intended Learning Outcomes .....	3
3.2	Content delivery.....	4
3.2.1	Lectures.....	4
3.2.2	Assignments and Supervisions.....	4
3.2.3	Laboratories .....	5
3.3	Assessment .....	5
3.3.1	Class tests.....	5
3.3.2	End of course examination .....	5
3.3.3	Continuous Assessment components.....	6
3.3.4	Overall performance calculation.....	6
3.3.5	Penalties for late submission of course work .....	6
3.4	Course Materials .....	7
3.4.1	Uploading to social media.....	7
3.5	Minimum requirements to avoid CR.....	7
3.6	Absence policy .....	8
3.7	Resit Examination .....	9
3.8	How to get the best from your studies.....	10
3.9	Progression: the next steps.....	10
4	Adverse Circumstances .....	11
5	Student societies.....	11
6	Getting help and advice .....	11

## 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<sup>i</sup>, and we support the University's Dignity at Work and Study policy<sup>ii</sup>. 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

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<sup>i</sup> <https://www.gla.ac.uk/myglasgow/senateoffice/studentcodes/studentconductstaff/>

<sup>ii</sup> <https://www.gla.ac.uk/myglasgow/humanresources/equalitydiversity/dignityworkstudyover/>

## 2 General Information and Introduction

Astronomy 2 is a 30 credit module, designed to be a link between the elementary astronomy of level 1 and a combined honours degree in Astronomy and Physics or Astronomy and Mathematics, or a single honours degree in Physics with Astrophysics.

The class consists of lectures on Tuesdays and Wednesdays, together with a class tutorial or a small group supervision session, or occasionally a third lecture, on Thursdays. Thus Astronomy 2 students attend on 3 days per week, throughout the year. Laboratory sessions are held at the Acre Road Observatory: 12 sessions spread over the two teaching periods, during which 4 experiments are completed by students working in pairs.

Fast Facts	
Course title	Astronomy Level 2 (A2)
Course Credits	30 credit level 2
Semesters taught	1 and 2
Lecture days	Tuesday, Wednesday and Thursday at 11am
Laboratory days	Wednesdays and Fridays, 2pm – 5pm Acre Rd Observatory
Supervisions	4 small-group sessions each semester
Essential Prerequisites	Normally at least D3 in Astronomy level 1
Important dates:	Planetarium session: to be announced
Class test(s)	See timetable in A2 Moodle
Key Personnel : Class head	Prof Ik Siong Heng (rm 252c, ext 6406) ik.heng@glasgow.ac.uk
Key Personnel : Lab head	Dr Iain Hannah (rm 617, ext 5182) iain.hannah@glasgow.ac.uk

## 3 Course Description

Astronomy 2 forms a bridge between Levels 1 and 3, consolidating the elementary material and introducing more advanced concepts in preparation for Honours. Astronomy 2 focuses on 4 main themes: Observational Astrophysics, Theoretical Astrophysics, Stars and their Spectra, and Relativity and Gravitation.

On completing this course, students will have a clear understanding of:

- ✦ Modern astronomical observations and instrumentation
- ✦ Stellar phenomenology and classification
- ✦ Quantum and statistical concepts in an astrophysical context
- ✦ The principles of special and general relativity.

### 3.1 Intended Learning Outcomes

On successful completion of this course, a student should be able to:

- ✦ Describe modern astronomical observing methods and instrumentation design
- ✦ Demonstrate a practical experience of making astronomical observations, data collection and manipulation, and the ability to use appropriate laboratory apparatus
- ✦ Explain clearly stellar phenomenology, including classification schemes and spectral features

- ✦ Show a clear grasp of the basic theoretical and statistical ideas needed to interpret radiation from astrophysical objects, and proficiency in applying these to astrophysical problems.
- ✦ Understand the fundamental concepts of relativity and gravitation, with an appreciation of the underlying principles of Special and General Relativity.

## 3.2 Content delivery

A2 is nominally taught by lectures, laboratories, assignments and supervision sessions.

### 3.2.1 Lectures

There are 4 lecture courses:

#### 3.2.1.1 *Observational Astrophysics (Lecturer: Prof Heng)*

Expanding on Astronomy 1, these 10 lectures will investigate quantitatively the observational tools and methods of data collection and reduction which underpin modern astrophysical observations. Quantitative material will also be presented to enable 'rule of thumb' estimates to be made of signal-to-noise ratios associated with various relevant experiments and measurements.

#### 3.2.1.2 *Relativity and Gravitation (Lecturers: Dr Gray)*

A 15-lecture course designed to give a quantitative account of special relativity, with particular applications in astronomy. The lectures introduce the relativistic kinematics required in high-energy astrophysics and present the concepts of metrics and curvature, as an introduction to general relativity and theoretical cosmology.

#### 3.2.1.3 *Stars and their Spectra (Lecturer: Dr Casey)*

These 10 lectures extend the basic knowledge gained in Astronomy 1 related to stellar phenomena, and will consolidate understanding of radiation laws, and deepen the treatment of the line and continuum spectra of stars and their relationship to observable quantities. A range of stellar phenomenology and behaviour will be presented together with basic astrophysical interpretations.

#### 3.2.1.4 *Theoretical Astrophysics (Lecturers: Prof Fletcher)*

A key area of astrophysics is the interpretation of spectra from many different sources, including planets, stars, nebulae and galaxies. This requires awareness of the relevant atomic and radiation knowledge, and of the statistical distribution of photons, electrons and ions in such sources. These 15 lectures will outline the basics of the required physics, and apply them to astrophysical situations.

*The brief lecture course descriptions above will be augmented by Aims and Objectives, and course summaries, issued by the lecturer during each lecture course. Students are encouraged to use this guide and the Aims and Objectives for study and as a checklist for revision but **PLEASE NOTE**: in response to feedback from students during the year, lecturers may omit or modify some material listed in the Course Component Aims and Objectives. Any such changes will be announced in the course of the lectures. Students are advised not to restrict their study to the topics mentioned, and are expected to think about, read around, and solve problems in these topics, in order to learn how to apply the concepts in unfamiliar contexts*

### 3.2.2 Assignments and Supervisions

Assignment questions are published on Moodle, with responses also to be uploaded to Moodle for marking and assessment by the course lecturers. Please ensure that your uploaded scripts are scanned

appropriately and are legible; inappropriate format or illegible uploads will be rejected. Marks scored in your assignments will count as a continuous assessment element in your overall performance, and a minimum level of 50% of the continuous assessment work MUST be completed in order to receive ANY credit from A2, so it is vital that you attempt each assignment. The maximum score on each assignment varies from assignment to assignment. Marked scripts will be returned, usually one week after the deadline for completion of the assignment. Please keep them as a part of the portfolio of written work.

Students are allocated to a supervision group consisting of 4-6 students and a staff member acting as supervisor. Each group meets with its supervisor on specified Thursdays (see timetable on MOODLE 2). During these sessions students will have the opportunity to discuss any problems arising in any aspect of the course. To get the best out of these sessions, notify your supervisor in advance of the sorts of problems you want to discuss: you can do this by email, telephone, in person or even on a scrap of paper pushed under the office door of your supervisor! These sessions also provide a forum for more general discussions and even small presentations by the students. They are an essential part of the course: prepare for them, get involved, and you will reap the benefits.

### **3.2.3 Laboratories**

There are 12 three-hour laboratory sessions covering astronomical instrumentation, data gathering and interpretation, and computing, giving a total of 36 hours laboratory work. The first laboratory session is in October as announced by Astronomy 2 Lab Head.

Students work in pairs and complete four lab experiments which will be used in the practical assessment. In addition to the normal laboratory record of performance, students will be asked to submit two full reports on experiments performed during the session. A report is due to be submitted after the end of each semester. Laboratory work contributes to the second year result, and a minimum performance threshold must be satisfied to gain ANY credit from Astronomy 2 (see Minimum Requirements). Note that the Practical score is based on 4 laboratory experiment records and 2 laboratory reports, each graded on the 22-point scale. The 4 records contribute 10% of the overall A2 grade, the two reports another 10% of the overall A2 grade (see Section 3.3.4). The laboratory handbook containing details of the experiments and good experimental procedure is an accompanying document to this one.

## **3.3 Assessment**

### **3.3.1 Class tests**

There will be 50-minute long class tests in Semesters 1 and 2. These tests will be held during class time, and will be based on tutorial-type questions. The Class Tests are compulsory and each contributes 10% to your overall course grade.

### **3.3.2 End of course examination**

This examination (worth 50% of the total available marks) is held normally in May, with the resit examination usually in August [see Registry webpage for exact date/time]. Both have the same structure and consist of a single two hour paper, which will be single marked by the course lecturers. Past papers will be made available to the students: make sure you get the relevant copies.

### 3.3.3 Continuous Assessment components

The tutorial assignments will count for 10% of the total mark available. Laboratory work will also be assessed, both as experimental practice (lab record) and report writing. The 4 laboratory records combined are 10% of the overall A2 grade, the 2 laboratory reports another 10% (see section 3.3.4).

### 3.3.4 Overall performance calculation

The class tests, continuous assessment elements and final written exam are combined to produce an overall grade as follows:

<b>End of course exam</b>	50%
<b>Class Tests</b>	20%
<b>Laboratory</b>	20%
<b>Assignments</b>	10%
<b>TOTAL</b>	100%

Each candidate who has satisfied the minimum requirement for the award of credits shall be awarded a grade, and shall earn the 30 credits for this course. This is summarised in the table below:

GRADE	GRADE DESCRIPTOR	%
A	Excellent	>70%
B	Very good	60-69%
C	Good	50-59%
D	Satisfactory	40-49%
E	Fair	30-39%
F	Poor	20-29%
G	Very poor	10-19%

### 3.3.5 Penalties for late submission of course work

Lab records/reports and tutorial assignments are subject to penalties for late submission (in the absence of good cause). The penalty is that, in the absence of medical or other certified absence, 10% of the maximum mark will be lost per working day overdue for each item; after 5 days the grade awarded for that item is H (ie zero).

### 3.4 Course Materials

The recommended course text book:

An Introduction to Modern Astrophysics, by B W Carrol & D A Ostlie, published by Addison-Wesley ISBN 0-201-54730-9. This book is considered essential for the Astronomy 2; all students are expected to have access to a copy.

For wider background reading, students may find the following list useful:

Principles of Cosmology and Gravitation, by M V Berry, Hilger

Introduction to Stellar Astrophysics, Vol 1: Basic Stellar Observations and Data, by Böhm-Vitense, CUP.

Astrophysical Techniques, Kitchin, Hilger

Astronomical Observations, Walker, CUP

Astronomy - Principles and Practice, 3rd Ed, A E Roy & D Clarke, Hilger

Special Relativity, French, Chapman & Hall

Stars and their Spectra, Kaler, CUP

Fundamental Astronomy, Second Enlarged Edition, H Karttunen, P Kröger, H Oja, M Poutanen and K J Donner, Editors, Springer Verlag

#### 3.4.1 Uploading to social media

The Learning and Teaching Committee (LTC) and Education Policy and Strategy Committee (EdPSC) have issued the following policy statement in respect of unauthorised web pages:

"Please note that lecture recordings and ALL course materials provided are for your own personal use and can only be used in relation to your studies. Any unauthorised distribution of course materials, including uploading them onto unauthorised web sites and social media sites, such as YouTube or Course Hero, will be considered in breach of the code of conduct and will be subject to disciplinary action."

### 3.5 Minimum requirements to avoid CR

In order to satisfy the minimum requirements for the award of grade, a student must normally complete 75% of the assessment (including the exam) in the course. For Astronomy 2, the following minimum requirements apply. Students must:

1. Attend at least 50% of the laboratory sessions and submit the associated work for marking.
2. Attend at least 50% of the class tutorials and supervisions, and submit at least 50% of the written work.
3. Attend the end of course exam.

Note that normally no grade or credits shall be awarded to a candidate who does not satisfy the minimum requirements detailed above.

The additional details on assessment can be found at the Senate pages:

<http://www.gla.ac.uk/services/senateoffice/policies/assessment/>

### 3.6 Absence policy

You need to report any absence from your studies which causes you to miss:

- Compulsory labs, lectures or supervisions
- Assignment deadlines
- Class tests
- Examinations
- More than 7 consecutive days during semester time.

Note that if you can arrange a suitable alternative (for example, a different lab day) then you needn't report the absence formally under MyCampus (via an Absence Record). Full details on the University's policy are given at

<http://www.gla.ac.uk/services/senateoffice/policies/studentssupport/absencepolicy/>

A table extracted from the Student Absence Policy offers a useful summary:

Consecutive days absent during working periods	Qualifier	Significant?	Absence notification via MyCampus required?	Reason for Absence	Medical Documentation required?	Other Documentation required?
7 or less	No examination missed; nothing missed which would impact on the fulfilment of published minimum requirement for the award of credit	NO	NO <sup>5,7</sup>	Medical	NO	NO
				Other	NO	NO
	Examination missed; at least one event missed which would impact on the fulfilment of published minimum requirements for the award of credit	YES	YES	Medical	NO <sup>8</sup>	YES
				Other	NO	YES
More than 7	-	YES	YES	Medical	YES	NO <sup>9</sup>
				Other	NO	YES

Note that suitable types of medical documentation include: a medical certificate; a medical report; a note from a hospital; a formal notification of a hospital or clinic appointment. Other suitable documentation include: independent corroboration from a responsible person; evidence from a staff

member alerted to the circumstances at the time; a letter from a student counsellor or other professional showing consultation at the time in question; a note from the police.

The table below is an extract from the Student Guidance on the Absence Reporting System, and offers additional insight.

Event	Suitable Contact
Lectures, labs and seminars	Relevant Tutor or Lecturer
Coursework deadlines and examinations	Relevant Course Coordinator
General absence	Adviser of Studies
Pregnancy-related absence	Adviser of Studies or another member of staff with whom you may feel more comfortable
Maternity support / paternity leave	Adviser of Studies or other School / College member of staff
Time out of study to fulfil caring responsibilities	Adviser of Studies, School or College member of staff
Faith-based event or holiday	Adviser of Studies, Head of School, Course Convener or other appropriate member of staff ( <b>but</b> advance permission to be absent from classes and / or examinations must be requested as early as possible after class enrolment)

### 3.7 Resit Examination

Students should note that a formal opportunity for re-assessment will be provided only for the degree examination paper. For all other assessment components of Astronomy 2, there may be the possibility of remedying a shortfall in required submissions; please contact the Class Head for further information.

A candidate who is awarded a grade of at least D3 after the first examination diet will not normally be allowed to resit the examination. Any other candidate entitled to sit the end-of-course examination shall be entitled to resit the examination, but normally only once, and at the next available diet.

### 3.8 How to get the best from your studies

Students are expected to attend all the lectures, labs and supervision sessions. Keep on top of your workload – try not to accrue a back-log of unfulfilled assignments or unreviewed lecture notes. It's best if you have full access to the recommended course text for private study – don't forget, there is a very comprehensive University Library! Reading around the subject areas will help clarify any points you don't understand; don't depend exclusively on your lecture notes. Get help from the lecturer or supervisor when you need it: a question after a lecture, or privately at another time can be very helpful – don't hesitate to approach the staff. The following list of points might be helpful:

- ✦ Clip the Aims & Objectives for each course into the relevant folder of notes, and use them as a template for organising your studies.
- ✦ Try and review the lecture notes regularly, and read ahead before the lectures.
- ✦ Don't retype or rewrite your lecture notes: this effort is very often worthless, but it does give the illusion of hard work! Instead, try and summarise the material presented: this will force you to concentrate on the key points, and will help you pinpoint exactly where your understanding fails.
- ✦ Use your summary notes as a reference guide to reading around, and make sure you consult the course textbook. This activity will also help you prepare for supervision sessions.
- ✦ It might be a good idea to form a study group, where a small number of you get together to sort out difficulties with the course, though this doesn't suit everyone!
- ✦ Don't leave exam studying until the last minute. As the date of the A2 class tests and final examination approach, there will be other pressures on you from other examinations, laboratory deadlines, tutorial questions to catch up on, etc; the time will disappear.
- ✦ Try and set aside some time every day to read through your notes and get on with private study.
- ✦ Make use of the library (GUL and the Astrosoc/Physoc library) to get some uninterrupted reading done, and don't stick only to the recommended text.
- ✦ Don't forget that Hillhead Public Library is very quiet, and often has spaces where you can work in a different environment, which can sometimes stimulate the jaded student!
- ✦ Finally, remember there is a temptation always to study what you know already, and to pretend that the material you haven't yet grasped will somehow be OK later: it won't! Get those areas of uncomfortable doubt cleared up, if not by reading around, then in the supervisions and tutorials.

Don't be tempted to copy from your fellow students: plagiarism is a serious issue (see p53 of the Calendar for a detailed description of plagiarism, and the University policy on it: <http://www.gla.ac.uk/services/senateoffice/policies/calendar/calendar2015-16/contents/>).

### 3.9 Progression: the next steps

We hope you will continue with your astronomy studies. Astronomy is offered as a Combined Honours degree with either Physics or Mathematics, each at BSc or MSci level; for details about entrance requirements, see the relevant part of the general section in the School Handbook.

## 4 Adverse Circumstances

This is the place to let students know what they should do in the event of illness or other 'good cause' circumstances: a brief description, plus a link to the university calendar for the official position. The 'Getting help and advice' section following this one is related; might be best to provide info here on what to do if you miss an exam or practical, or if you are ill for a few days and need to self certificate. Where there are more complex or involved circumstances (family problems, chronic conditions, depression etc) then refer to the 'getting help and advice section' for more detailed info.

## 5 Student societies

The School provides a common room on level 4, open to staff and all students enrolled in school courses. The common room has vending machines and can be used for study, though it isn't quiet. The student library is located in room 332 and has a small study area, in which a copy of every course textbook can be found. Access information is displayed on the main notice boards throughout the building, and in the common room itself.

AstroSoc is the student astronomical society, which undertakes to arrange social events and invited talks on burning issues of relevance to modern astronomers. Why not liven up your academic life, and participate socially? Don't forget the other student organisation within the School: Physoc. Membership of these two societies should brighten up many aspects of your career! See <http://www.gla.ac.uk/schools/physics/undergraduate/undergraduatestudy/theschool/> for further details.

## 6 Getting help and advice

Don't forget that there are also professionals on the campus who can offer confidential and sympathetic advice on personal matters: the Student Counselling Service (<http://www.gla.ac.uk/services/counselling/>) is there to help.

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