



# ASTR278

## Advanced Astronomy

S2 Day 2016

*Dept of Physics and Astronomy*

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#### **Disclaimer**

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## General Information

Unit convenor and teaching staff

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Credit points

3

Prerequisites

(MATH132 or MATH135) and [(PHYS143 and PHYS140) or (PHYS106 and PHYS107)]

Corequisites

Co-badged status

Unit description

This unit is designed to give students an appropriate background and theoretical understanding of astronomical observations and selected topics in galaxy and stellar evolution. Fundamental limits to sensitivity, angular and spectroscopic resolution are explored, as well as the technology to reach these limits, including active and adaptive optics. Key concepts of multi-wavelength imaging and spectroscopy are discussed, including the role of optical fibres. The unit also specifically covers the effects of the earth's atmosphere; detection theory and detectors; and associated image processing techniques. Aspects of galaxy structure, galaxy formation and stellar evolution will be covered that draw upon mathematical methods learnt in first year. This unit involves practical experiments based on some of these concepts and may involve evening work at the University's optical and radio observatory.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

## Learning Outcomes

On successful completion of this unit, you will be able to:

Demonstrate an understanding of astronomical units and coordinate systems in solar-system, stellar and extragalactic astronomy through an ability to make credible observing plans.

Familiarity with basic python programming and its application to preparing astronomical

imaging for analysis.

Describe the concepts behind and solve problems about astronomical telescopes and their associated imaging and spectroscopic instruments.

Describe the concepts behind and solve problems about the effects of the Earth's atmosphere on astronomical imaging.

Describe concepts behind and solve problems about technologies used in optical and infrared astronomy including adaptive optics, fibre-optics, and astrophotonics

Describe concepts behind and solve problems about observing techniques and technologies in optical, radio and other wavelength regimes.

Understand advanced topics in stellar and galactic astronomy.

## General Assessment Information

This unit has (a) hurdle requirement(s), specifying a minimum standard that must be attained in (an) aspect(s) of the unit. To pass this unit you **must obtain a mark of at least 50% in the unit overall as well as 40% in the final examination.**

## Assessment Tasks

Name	Weighting	Due
<u>Assignments</u>	20%	3, 6, 10, 13
<u>Full lab report</u>	15%	3 weeks after lab
<u>Labs</u>	25%	1 week after each lab
<u>Final examination</u>	40%	University Examination Period

### Assignments

Due: **3, 6, 10, 13**

Weighting: **20%**

Assignments contribute 20% of your total course mark. Four assignments will be handed out at appropriate points during the unit.

You must show your working in numerical questions to obtain full marks - how you get to an answer is probably more important than the answer itself!

Late submission policy is available on the unit's iLearn page. Please email the relevant lecturer if you anticipate a late submission.

Some of the questions in the final examination paper will be similar to those set for assignments.

On successful completion you will be able to:

- Describe the concepts behind and solve problems about astronomical telescopes and their associated imaging and spectroscopic instruments.
- Describe the concepts behind and solve problems about the effects of the Earth's atmosphere on astronomical imaging.
- Describe concepts behind and solve problems about technologies used in optical and infrared astronomy including adaptive optics, fibre-optics, and astrophotonics
- Describe concepts behind and solve problems about observing techniques and technologies in optical, radio and other wavelength regimes.
- Understand advanced topics in stellar and galactic astronomy.

## Full lab report

Due: **3 weeks after lab**

Weighting: **15%**

A full laboratory report will be submitted for one of the first few laboratories. This report will be in the form of a research paper, and it is expected that you will read widely in order to make a comprehensive introduction to the report. More details on the form and content will be available on iLearn.

On successful completion you will be able to:

- Describe the concepts behind and solve problems about astronomical telescopes and their associated imaging and spectroscopic instruments.
- Understand advanced topics in stellar and galactic astronomy.

## Labs

Due: **1 week after each lab**

Weighting: **25%**

The small reports will be expected to be in the laboratory book. Each report is due 1 week after completion of the lab. The marks will be based on completion of the laboratory exercises where possible, a demonstrated understanding of the material in your report and adherence to good experimental practice.

On successful completion you will be able to:

- Demonstrate an understanding of astronomical units and coordinate systems in solar-system, stellar and extragalactic astronomy through an ability to make credible observing plans.
- Familiarity with basic python programming and its application to preparing astronomical imaging for analysis.
- Describe the concepts behind and solve problems about astronomical telescopes and

their associated imaging and spectroscopic instruments.

- Describe concepts behind and solve problems about technologies used in optical and infrared astronomy including adaptive optics, fibre-optics, and astrophotonics
- Describe concepts behind and solve problems about observing techniques and technologies in optical, radio and other wavelength regimes.
- Understand advanced topics in stellar and galactic astronomy.

## Final examination

Due: **niversity Examination Period**

Weighting: **40%**

The basic format will follow that of previous years. Calculators which do not have a full alphabet on the keyboard will be allowed into the examination.

*The final examination is a hurdle requirement. You must obtain a mark of at least 40% to pass the unit. If your mark in the final examination is between 30% and 39% inclusive then you will be given a second and final chance to attain the required level of performance.*

On successful completion you will be able to:

- Describe the concepts behind and solve problems about astronomical telescopes and their associated imaging and spectroscopic instruments.
- Describe the concepts behind and solve problems about the effects of the Earth's atmosphere on astronomical imaging.
- Describe concepts behind and solve problems about technologies used in optical and infrared astronomy including adaptive optics, fibre-optics, and astrophotonics
- Describe concepts behind and solve problems about observing techniques and technologies in optical, radio and other wavelength regimes.
- Understand advanced topics in stellar and galactic astronomy.

## Delivery and Resources

### Classes

Students are expected to attend all lectures. Lecture attendance provides students with the opportunity to ask questions, interact with fellow students, receive assignments and participate in the life of the University.

### Required and Recommended Texts and/or Materials

#### Required Text

There is no single textbook that covers all of the course material in this unit. Appropriate material

will be provided during the course. Useful textbooks are listed below, and useful web resources at the end of this document.

### Recommended Reading/Useful References

Foundations of Astrophysics by Barbara Ryden, Addison-Wesley, (2009)

Observational Astrophysics by Robert C. Smith, Cambridge University Press (1995)

Astrophysical Techniques, C R Kitchin, Institute of Physics Publishing (2003)

Adaptive Optics for Astronomical Telescopes, John W Hardy, Oxford University Press (1998)

Astrophysical quantities, C W Allen, London : Athlone Press (1973) ISBN0485111500e

## Teaching and Learning Strategy

This unit is taught through lectures and through undertaking laboratory experiments. Questions during and outside lectures are strongly encouraged in this unit - please do not be afraid to ask as it is likely that your classmates will also want to know the answer. You should aim to read the relevant sections of the textbook and the notes provided online before and after lectures and discuss the content with classmates and lecturers.

## Unit Schedule

Laboratories (practicals) are compulsory and will commence in the second week of semester.

Weather pending, some optional laboratory exercises will be at the Macquarie Observatory from sunset on other days by prior arrangement. Data collected at the observatory will be used in the laboratory sessions, and one data collection evening will remove the requirement to attend one laboratory session.

Students are expected to attend all lectures. Lecture attendance provides students with the opportunity to ask questions, interact with fellow students, receive assignments and participate in the life of the University.

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](#). Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy [http://mq.edu.au/policy/docs/academic\\_honesty/policy.html](http://mq.edu.au/policy/docs/academic_honesty/policy.html)

**New Assessment Policy in effect from Session 2 2016** [http://mq.edu.au/policy/docs/assessment/policy\\_2016.html](http://mq.edu.au/policy/docs/assessment/policy_2016.html). For more information visit [http://students.mq.edu.au/events/2016/07/19/new\\_assessment\\_policy\\_in\\_place\\_from\\_session\\_2/](http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/)

Assessment Policy prior to Session 2 2016 <http://mq.edu.au/policy/docs/assessment/policy.html>

Grading Policy prior to Session 2 2016 <http://mq.edu.au/policy/docs/grading/policy.html>

Grade Appeal Policy <http://mq.edu.au/policy/docs/gradeappeal/policy.html>

Complaint Management Procedure for Students and Members of the Public [http://www.mq.edu.au/policy/docs/complaint\\_management/procedure.html](http://www.mq.edu.au/policy/docs/complaint_management/procedure.html)

Disruption to Studies Policy [http://www.mq.edu.au/policy/docs/disruption\\_studies/policy.html](http://www.mq.edu.au/policy/docs/disruption_studies/policy.html) *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the [Learning and Teaching Category](#) of Policy Central.

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: [https://students.mq.edu.au/support/student\\_conduct/](https://students.mq.edu.au/support/student_conduct/)

## Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit [ask.mq.edu.au](http://ask.mq.edu.au).

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

## Learning Skills

Learning Skills ([mq.edu.au/learningskills](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

## Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

## Student Enquiries

For all student enquiries, visit Student Connect at [ask.mq.edu.au](http://ask.mq.edu.au)

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

## Graduate Capabilities

### Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

### Learning outcomes

- Demonstrate an understanding of astronomical units and coordinate systems in solar-system, stellar and extragalactic astronomy through an ability to make credible observing plans.
- Familiarity with basic python programming and its application to preparing astronomical imaging for analysis.
- Describe the concepts behind and solve problems about astronomical telescopes and their associated imaging and spectroscopic instruments.
- Describe the concepts behind and solve problems about the effects of the Earth's atmosphere on astronomical imaging.
- Describe concepts behind and solve problems about technologies used in optical and infrared astronomy including adaptive optics, fibre-optics, and astrophotonics
- Describe concepts behind and solve problems about observing techniques and technologies in optical, radio and other wavelength regimes.
- Understand advanced topics in stellar and galactic astronomy.

### Assessment tasks

- Assignments
- Full lab report
- Labs
- Final examination

### Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to



have a level of scientific and information technology literacy.

This graduate capability is supported by:

## **Learning outcomes**

- Demonstrate an understanding of astronomical units and coordinate systems in solar-system, stellar and extragalactic astronomy through an ability to make credible observing plans.
- Familiarity with basic python programming and its application to preparing astronomical imaging for analysis.
- Describe the concepts behind and solve problems about astronomical telescopes and their associated imaging and spectroscopic instruments.
- Describe the concepts behind and solve problems about the effects of the Earth's atmosphere on astronomical imaging.
- Describe concepts behind and solve problems about technologies used in optical and infrared astronomy including adaptive optics, fibre-optics, and astrophotonics
- Describe concepts behind and solve problems about observing techniques and technologies in optical, radio and other wavelength regimes.
- Understand advanced topics in stellar and galactic astronomy.

## **Assessment tasks**

- Assignments
- Full lab report
- Labs
- Final examination

## **Problem Solving and Research Capability**

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

## **Learning outcomes**

- Familiarity with basic python programming and its application to preparing astronomical imaging for analysis.
- Describe the concepts behind and solve problems about astronomical telescopes and their associated imaging and spectroscopic instruments.

- Describe the concepts behind and solve problems about the effects of the Earth's atmosphere on astronomical imaging.
- Describe concepts behind and solve problems about technologies used in optical and infrared astronomy including adaptive optics, fibre-optics, and astrophotonics
- Describe concepts behind and solve problems about observing techniques and technologies in optical, radio and other wavelength regimes.
- Understand advanced topics in stellar and galactic astronomy.

## **Assessment tasks**

- Assignments
- Full lab report
- Labs
- Final examination

## **Effective Communication**

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

## **Assessment tasks**

- Full lab report
- Labs