ASTR278

Advanced Astronomy

S2 Day 2015

Dept of Physics and Astronomy

Contents

General Information

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By appointment

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 Earths 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

iLearn will contain more details about each of these. Submit the assignments and full lab reports on iLearn. Late submission policy will be available on iLearn.

Assessment Tasks

Name	Weighting	Due
Assignments (4)	20%	Weeks 3, 6, 10, 13
Full Lab Report	10%	3 weeks after lab.
Labs	20%	1 Week after each lab
Final Examination	50%	University Examination Period

Assignments (4)

Due: **Weeks 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 iLearn. 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:

- Demonstrate an understanding of astronomical units and coordinate systems in solar-system, stellar and extragalactic astronomy through an ability to make credible observing plans.
- 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 Earths 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: **10%**

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:

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

Labs

Due: **1 Week after each lab**
Weighting: **20%**

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 the concepts behind and solve problems about the effects of the Earths 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.

Final Examination

Due: **University Examination Period**
Weighting: **50%**

The final examination will be three hours duration. 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.

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.
- 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 Earths atmosphere on astronomical imaging.
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- 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 first week of semester. Weather pending, some optional laboratory exercises will be at the Macquarie Observatory from sunset on other weeknights (Monday through Thursday) 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.

Lectures and labs will be conducted during week 13.

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

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

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

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy 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/

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.

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) 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

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Assessment task

- Full Lab Report

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Assessment task

- Full Lab Report

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcome

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

Assessment task

- Assignments (4)

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 Earths 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
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- Understand advanced topics in stellar and galactic astronomy.

Assessment tasks

- Assignments (4)
- 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

- Familiarity with basic python programming and its application to preparing astronomical imaging for analysis.
- Describe the concepts behind and solve problems about the effects of the Earths 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 (4)
- 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

- 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.
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- Understand advanced topics in stellar and galactic astronomy.

Assessment tasks

- Assignments (4)
- 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

General Reminders

Student Liaison Committee

The Department of Physics and Astronomy values quality teaching and engages in periodic student evaluations of its units, external reviews of its programs and course units, and seeks feedback from students via focus groups and the Student Liaison Committee (SLC). Please consider being a member of the SLC, which meets once during the semester with the purpose of improving teaching via student feedback. Meetings are open and friendly, and invite honest feedback. Student representatives receive a list of outcomes from the preceding meeting. At the beginning of each meeting, an update on responses to feedback is provided by the Head of Department. Feedback is acted upon in a number of ways, mostly initiated via department meetings where decisions on actions are taken.

Student Support Services

Macquarie University provides a range of Academic Student Support Services. Details of these services can be accessed at http://www.mq.edu.au/currentstudents/ .

Standards Expectation

Grades

The broad standards as defined by the academic senate can be found at http://www.mq.edu.au/policy/docs/grading/policy.html. nterpretation of these guidelines as they apply to this course are:

High distinction (HD, 85-100%)

Demonstrates exceptional understanding of the relevant physics concepts; problems are completed with correct solutions and appropriate working and clear relevant diagrams; student able to apply standard theory to solve standard problems and novel problems.

Distinction (D, 75-85%)

Demonstrates very good understanding of the relevant physics concepts; problems are completed with occasional numerical error or incomplete working; student able to apply standard theory to solve standard problems; some ability to apply taught material to novel problems or situations.

Credit (Cr, 65-75%)

Demonstrates good understanding of the relevant physics concepts; most problems completed correctly; student able to apply standard theory to solve standard problems

Pass (P, 50-65%)

Demonstrates good understanding of at least half of the relevant physics concepts; some problems completed correctly; student able to apply this knowledge in some standard problems.

Fail (F,0-49%)

Inadequate demonstration of knowledge, understanding, and ability to apply knowledge to solving problems.

Special Consideration

The only exception to not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for Special Consideration. The University's policy for applying for Special Consideration may be found at:

http://www.student.mq.edu.au/ses/Special%20Consideration.html