ASTR707

Advanced Astrophysics

S2 Day 2019

Dept of Physics and Astronomy

Contents

General Information

Unit convenor and teaching staff
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Credit points
4

Prerequisites
Admission to MRes

Corequisites

Co-badged status

Unit description
This unit covers the fundamental physics of celestial objects such as stars and galaxies. It starts with the physics of fluid dynamics and the interaction of matter with light; these concepts are then used to describe the interstellar medium, including star formation and the stellar feedback of energy and new elements. The unit concludes with a discussion of galactic formation and evolution from the standpoints of interstellar gas and stellar populations. Observations of real celestial objects are used throughout the unit as examples of the processes we need to explain. Throughout the unit strong emphasis is placed on the connection between observations and interpretation. The student will gain an understanding of how different types of observations (imaging, spectroscopy, multi-wavelength approaches, survey approaches) can allow us to gain insight into specific astrophysical situations and how these observations can be interpreted in the light of theory. The scientific method will be used and emphasised as the backbone of all research and its stages underlined during class and all the activities.

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:

Understand stellar pulsations and role this plays in stellar evolution and mass loss.

Understand the synthesis of elements in stars and their observed chemical abundances

Understand the dynamics of gas flows in Astrophysical environments (including magnetic fields, shocks and viscosity). Applications to disks and jets will be discussed in particular.

Solve problems in real-time during class tutorials, and demonstrate solutions to peers

Learn to communicate complex physical concepts in writing and orally.

Learn how to exploit computers to solve astrophysical problems.

General Assessment Information

In order to pass the unit, you need to obtain a total mark of at least 50%, as well as a mark of at least 40% in the final exam.

Oral assessment: On 4 separate weeks the students will be given a week to read a set of notes and book pages. In order to digest the material the students are asked to print and annotate the pages, including answering a questionnaire and to be prepared to explain any part of the material to their peers in class during a 2 hour long round table discussion. Part of the material will be new to the students and part will be from content already presented. It is not expected that students understand everything they read. However, it is expected that they are able to present questions about any aspects that they do not fully comprehend and that these questions be in the context of those concepts that they do understand. The ability to explain any concept

in a clear fashion and according to some pre-agreed specification (level of depth, time constraints, etc.) is a key skill to be mastered by any science student. This is why this assessment task is part of this unit.

This assessment task also allows the lecturer to "flip" part of the unit. The oral session where the students are presenting and discussing material that has not yet been presented by the lecturer, will allow the lecture time to be a far more interesting and in depth discussion session, rather than board presentation. The lecturer will be there to consolidate concepts and stimulate a deeper understanding.

Assignments: four exam style assignments will be given to prepare students for the type of questions they might be getting in the final exam and to test their general understanding and their problem solving skills. Programming a computer to answer questions that are not simple to answer in any other way is an essential skill not just in Astrophysics but in any job that require a science degree as a platform. In part of each assignment the student will write short computer codes to answer questions.

The final examination will be three hours long duration plus ten minutes reading time. The final examination is similar to the theoretical side of the Assignments in style, but is carried out under controlled conditions and without the help of books. Battery or solar powered calculators which do not have a full alphabet on the keyboard will be allowed into the examination. Calculators with text retrieval are not permitted for the final examination.

The final examination is a hurdle requirement. You must obtain a mark of at least 40% in the final exam to be eligible to pass the unit. If your mark in the final examination is between 30% and 39% inclusive, you may be a given a second and final chance to attain the required level of performance; the mark awarded for the second exam towards your final unit mark will be capped at 40%, and you will be allowed to sit the second exam only if this mark would be sufficient to pass the unit overall. If you receive special consideration for the final exam, a supplementary exam will be scheduled after results are released. Please see FSE101 in iLearn for dates. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination. Second chance exams for hurdle assessments will also be scheduled in this period.

You are expected to present yourself for the final examination at the time and place designated in the University examination timetable (http://www.timetables.mq.edu.au/). The timetable will be available in draft form approximately eight weeks before the commencement of examinations and in final form approximately four weeks before the commencement of examinations.

The only exception to not sitting the examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to apply for Special Consideration (see ‘Special Consideration’ in this Guide). If a supplementary examination is granted as a result of the special consideration process the examination will be scheduled after the conclusion of the official examination period. You are advised that it is the

policy of the University not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, i.e. the final day of the examination period.

Assessment Tasks

Name	Weighting	Hurdle	Due
Oral assessment	30%	No	Week 3, 6, 9, 12
Assignments	40%	No	Weeks 4, 5, 10 and 12
Final Exam	30%	Yes	University Exam Period

Oral assessment

Due: **Week 3, 6, 9, 12**
Weighting: **30%**

During 4 designated weeks, 2 hours will be spent discussing materials that the student was asked to read. Each student will be asked to present informally to the class one part of the assigned material.

On successful completion you will be able to:

- Understand stellar pulsations and role this plays in stellar evolution and mass loss. Understand the synthesis of elements in stars and their observed chemical abundances
- Understand the dynamics of gas flows in Astrophysical environments (including magnetic fields, shocks and viscosity). Applications to disks and jets will be discussed in particular.
- Solve problems in real-time during class tutorials, and demonstrate solutions to peers
- Learn to communicate complex physical concepts in writing and orally.

Assignments

Due: **Weeks 4, 5, 10 and 12**
Weighting: **40%**

Four assignments comprising mixed exam style questions and computer exercises.

On successful completion you will be able to:

- Understand stellar pulsations and role this plays in stellar evolution and mass loss. Understand the synthesis of elements in stars and their observed chemical abundances
- Understand the dynamics of gas flows in Astrophysical environments (including magnetic fields, shocks and viscosity). Applications to disks and jets will be discussed in particular.
- Learn to communicate complex physical concepts in writing and orally.

- Learn how to exploit computers to solve astrophysical problems.

Final Exam

Due: **University Exam Period**
Weighting: **30%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

A 3-hour (plus 10 minute reading time) exam will cover all lectured content. Questions will be problem-style as well as short answer style.

On successful completion you will be able to:

- Understand stellar pulsations and role this plays in stellar evolution and mass loss. Understand the synthesis of elements in stars and their observed chemical abundances
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- Learn to communicate complex physical concepts in writing and orally.

Delivery and Resources

The course will be delivered through weekly lectures and tutorial sessions. The unit will cover four parts:

1) Stellar Pulsations and Stellar Nucleosynthesis (6 weeks, lecturer Devika Kamath)

2) The physics of fluids, astrophysics of accreting gas in star formation and binary interactions (7 weeks, lecturer Orsola De Marco)

Each part will be assessed via oral sessions and assignments during the term, and will be approximately proportionally represented in the final exam.

Unit Schedule

Week 1-3: Stellar pulsation

Week 4: Stellar pulsation

Week 5: Stellar pulsation and nucleosynthesis

Week 6: Nucleosynthesis: the genesis of the elements

Week 7: The equations of fluid dynamics

Week 8: The equations of fluid dynamics and star formation

Week 9: Shocks

Week 10: Shocks and viscosity

Week 11: Viscosity and accretion disks (and maybe jets)

Week 12-13: Accretion disks and jets

Learning and Teaching Activities

Lecturing

Classic style lecturing using Powerpoint-style presentations including movies as well as white board demonstration will be carried out for an approximately 2.5 hours per week.

Tutorials

Approximately 1.5 hours per week will be dedicated to tutorials. These will include problem solving in small groups, class discussions, short presentations and Q and A sessions.

Presentations

On 4 designated weeks, the students will be assigned a range of reading materials that they will be asked to present in class.

Computer programming

Students will be using computer programming to solve problems as part of their assignments.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/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/study/getting-started/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) 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 or if you are a Global MBA student contact globalmba.support@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

If you are a Global MBA student contact globalmba.support@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/.

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

PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

Learning outcome

- Learn to communicate complex physical concepts in writing and orally.

Assessment task

- Oral assessment

PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

Learning outcomes

- Understand stellar pulsations and role this plays in stellar evolution and mass loss. Understand the synthesis of elements in stars and their observed chemical abundances
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- Solve problems in real-time during class tutorials, and demonstrate solutions to peers
- Learn to communicate complex physical concepts in writing and orally.
- Learn how to exploit computers to solve astrophysical problems.

Assessment tasks

- Oral assessment
- Assignments
- Final Exam

Learning and teaching activities

- Classic style lecturing using Powerpoint-style presentations including movies as well as white board demonstration will be carried out for an approximately 2.5 hours per week.
- Approximately 1.5 hours per week will be dedicated to tutorials. These will include

problem solving in small groups, class discussions, short presentations and Q and A sessions.
- On 4 designated weeks, the students will be assigned a range of reading materials that they will be asked to present in class.
- Students will be using computer programming to solve problems as part of their assignments.

PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

Learning outcomes

- Understand stellar pulsations and role this plays in stellar evolution and mass loss. Understand the synthesis of elements in stars and their observed chemical abundances
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PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

Learning outcomes

- Understand stellar pulsations and role this plays in stellar evolution and mass loss. Understand the synthesis of elements in stars and their observed chemical abundances
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- Students will be using computer programming to solve problems as part of their assignments.

PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

Learning outcomes

- Solve problems in real-time during class tutorials, and demonstrate solutions to peers

- Learn to communicate complex physical concepts in writing and orally.

Assessment tasks

- Oral assessment
- Assignments
- Final Exam

Learning and teaching activities

- Approximately 1.5 hours per week will be dedicated to tutorials. These will include problem solving in small groups, class discussions, short presentations and Q and A sessions.
- On 4 designated weeks, the students will be assigned a range of reading materials that they will be asked to present in class.

PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

Learning outcome

- Learn to communicate complex physical concepts in writing and orally.

Assessment task

- Oral assessment

Changes from Previous Offering

Modifications to the syllabus this year will be:

1) A slightly shorter section on stellar pulsations in the first part of the unit (lecturer Devika Kamath)

2) Slightly reduced emphasis on star formation with increased emphasis on accretion in general and disk formation and evolution. (lecturer Orsola De Marco)

Assessment was simplified as follows:

1) The class participation item was eliminated.

2) The presentation assessment substituted with 4 oral/presentation assessments.

3) The computer assessment was integrated into 4 regular assignments.

4) The short answer assessment task (class flip) was integrated into the oral presentation.