ASTR7907

Advanced Astrophysics

Session 2, Weekday attendance, North Ryde 2021

Department of Physics and Astronomy

Contents

Session 2 Learning and Teaching Update

The decision has been made to conduct study online for the remainder of Session 2 for all units WITHOUT mandatory on-campus learning activities. Exams for Session 2 will also be online where possible to do so.

This is due to the extension of the lockdown orders and to provide certainty around arrangements for the remainder of Session 2. We hope to return to campus beyond Session 2 as soon as it is safe and appropriate to do so.

Some classes/teaching activities cannot be moved online and must be taught on campus. You should already know if you are in one of these classes/teaching activities and your unit convenor will provide you with more information via iLearn. If you want to confirm, see the list of units with mandatory on-campus classes/teaching activities.

Visit the MQ COVID-19 information page for more detail.

General Information

Unit convenor and teaching staff
Convenor / Lecturer
Daniel Zucker
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Co-convenor / Lecturer
Devika Kamath Kotachery
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Credit points
10

Prerequisites
Admission to MRes

Corequisites

Co-badged status

Unit description
This unit covers advanced topics in Astrophysics. For example the physics of fluid dynamics applied to accretion disks and jets in astrophysical objects such as black hole binaries; the physics of star and planet formation; the genesis of the elements; or 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. Strong emphasis is placed on the connection between observations, interpretation and modelling. The scientific method will be used and emphasised as the backbone of all research. Computational techniques in modelling and/or in data analysis will also be used.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://students.mq.edu.au/important-dates

Learning Outcomes

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

ULO1: discuss stellar pulsations and role this plays in stellar evolution and mass loss.

ULO2: explain the synthesis of elements in stars and their observed chemical abundances.

ULO3: demonstrate an understanding of the dynamics of gas flows in Astrophysical

environments, including magnetic fields, shocks and viscosity.

ULO4: solve problems in real-time during class tutorials, and demonstrate solutions to peers

ULO5: communicate complex physical concepts in writing and orally.

ULO6: use numerical codes 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.

Assignments (25%): four exam-style assignments will be given to prepare students for the type of questions they could expect in the final exam, as well as to test their general understanding and 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 virtually any job that requires a science degree as a platform. In part of each assignment, the student will write short computer codes to answer questions.

Quizzes (15%): short quizzes will be scheduled approximately fortnightly, to help students keep up with the material covered, and to help identify any problematic concepts.

Class Presentations (30%): 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 be 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 a concept in a clear fashion and according to a pre-agreed specification (level of depth, time constraints, etc.) is a key skill to be mastered by any science student, which is why this assessment task is part of the unit.

This assessment task also allows the lecturer to "flip" part of the unit. The oral sessions in which 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 a board presentation. The lecturer will be there to consolidate concepts and stimulate a deeper understanding.

Final Examination (30%): The final examination will be three hours long duration plus ten minutes of 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.

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). 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.

If you receive special consideration for the final exam, a supplementary exam will be scheduled after results are released. 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.

Assessment Tasks

Name	Weighting	Hurdle	Due
Project-based assignments	25%	No	Week 4, 6, 10, 12
Weekly quizzes	15%	No	Week 2, 4, 6, 8, 10, 12
Class presentation	30%	No	Week 3, 5, 9, 11
Final examination	30%	No	University Examination Period

Project-based assignments

Assessment Type [1]: Project
Indicative Time on Task [2]: 20 hours
Due: **Week 4, 6, 10, 12**
Weighting: **25%**

One project in each half of the unit.

On successful completion you will be able to:

- discuss stellar pulsations and role this plays in stellar evolution and mass loss.
- explain the synthesis of elements in stars and their observed chemical abundances.

- demonstrate an understanding of the dynamics of gas flows in Astrophysical environments, including magnetic fields, shocks and viscosity.
- solve problems in real-time during class tutorials, and demonstrate solutions to peers
- communicate complex physical concepts in writing and orally.
- use numerical codes to solve astrophysical problems.

Weekly quizzes

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 13 hours
Due: **Week 2, 4, 6, 8, 10, 12**
Weighting: **15%**

Short weekly quizzes set at the beginning of the week.

On successful completion you will be able to:

- discuss stellar pulsations and role this plays in stellar evolution and mass loss.
- explain the synthesis of elements in stars and their observed chemical abundances.
- demonstrate an understanding of the dynamics of gas flows in Astrophysical environments, including magnetic fields, shocks and viscosity.
- solve problems in real-time during class tutorials, and demonstrate solutions to peers

Class presentation

Assessment Type [1]: Presentation
Indicative Time on Task [2]: 20 hours
Due: **Week 3, 5, 9, 11**
Weighting: **30%**

Leading class discussions on pre-assigned reading material

On successful completion you will be able to:

- discuss stellar pulsations and role this plays in stellar evolution and mass loss.
- explain the synthesis of elements in stars and their observed chemical abundances.
- demonstrate an understanding of the dynamics of gas flows in Astrophysical environments, including magnetic fields, shocks and viscosity.
- solve problems in real-time during class tutorials, and demonstrate solutions to peers

- communicate complex physical concepts in writing and orally.

Final examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **University Examination Period**
Weighting: **30%**

Exam in the University Exam period covering the content from the whole unit.

On successful completion you will be able to:

- discuss stellar pulsations and role this plays in stellar evolution and mass loss.
- explain the synthesis of elements in stars and their observed chemical abundances.
- demonstrate an understanding of the dynamics of gas flows in Astrophysical environments, including magnetic fields, shocks and viscosity.
- solve problems in real-time during class tutorials, and demonstrate solutions to peers
- communicate complex physical concepts in writing and orally.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Learning Skills Unit for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

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, and the astrophysics of accreting gas in star formation and binary interactions (~7 weeks, lecturer Daniel Zucker)

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

Unit Schedule

Week 1: Introduction to stellar variability and stellar pulsations, Introduction to P-L relations

Week 2: Classes of pulsating stars, including their pulsation characteristics.

Week 3: Analysis of time series data

Week 4: Basic nuclear-astrophysics concepts

Week 5: Introduction to the origin/synthesis of chemical elements

Week 6: Nucleosynthesis in low- and intermediate-mass stars.

Week 7 - 13: The physics of fluids, and the astrophysics of accreting gas in star formation and binary interactions. Details of the topics covered will be available on iLearn.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). 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

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

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/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 help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Enquiry Service

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

Equity 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.

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.

Learning and Teaching Activities

Lecturing

Classic style lecturing using Powerpoint-style presentations including movies as well as real-time problem solving 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.