UNSW Course Outline

ZPEM2509 Astrophysics - 2024

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General Course Information

Course Code : ZPEM2509
Year : 2024
Term : Semester 2
Teaching Period : Z2
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : UC Science
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

The course objective is to provide both an introduction to modern astronomy and the theoretical and experimental physics that lies behind it. A broad range of topics are covered from celestial sphere coordinate systems to dark energy. This 6 UOC course is part of a Physics major in Science. It will be assumed that students have a good working knowledge from the foundation

Physics 1 courses, ZPEM1501 and ZPEM1502, and that the student is proficient in Level 1 Mathematics.

Course Aims

The course objective is to provide both an introduction to modern astronomy and the theoretical and experimental physics (the astrophysics) that lies behind it. In addition, a more detailed examination will be made of a current topic in modern Astronomy & Astrophysics beyond what was possible in the Physics 1 and Physics 2 courses (e.g., stellar evolution).

Relationship to Other Courses

This course builds on the physical concepts developed in Physics 1 and Physics 2 courses (e.g. ZPEM1501, ZPEM1502, ZPEM2502) and applies them to astrophysical contexts. It also uses many of the mathematical techniques developed in Maths 1 courses, particularly in calculus and differential equations. Some of the important concepts from the ZPEM2506 Atmospheric Physics course will also be relevant to the study of stellar atmospheres and evolution.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : A working knowledge of the key concepts in the selected topic areas, demonstrated by the ability to think critically, discuss, describe and explain the topics.
CLO2 : An understanding of the physics behind astronomical observations and theoretical models, demonstrated by the ability to explain these processes and to solve numerical problems involving them.
CLO3 : A comprehension of current directions in research in astrophysics, exemplified through a short oral presentation.
CLO4 : By carrying out the four associated laboratory experiments, students should also gain (i) a deeper knowledge of stellar astrophysics, (ii) the ability to carry an experiment through to completion, to document the results, and to objectively consider the conclusions, (iii) experience in project preparation, team work, and self-directed learning.

Course Learning Outcomes	Assessment Item
CLO1 : A working knowledge of the key concepts in the selected topic areas, demonstrated by the ability to think critically, discuss, describe and explain the topics.	
CLO2 : An understanding of the physics behind astronomical observations and theoretical models, demonstrated by the ability to explain these processes and to solve numerical problems involving them.	
CLO3 : A comprehension of current directions in research in astrophysics, exemplified through a short oral presentation.	
CLO4 : By carrying out the four associated laboratory experiments, students should also gain (i) a deeper knowledge of stellar astrophysics, (ii) the ability to carry an experiment through to completion, to document the results, and to objectively consider the conclusions, (iii) experience in project preparation, team work, and self-directed learning.	

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Learning and Teaching in this course

The laboratory program will aide in practical understanding of some aspects of the course materials. The labs will not be recorded, nor will the tutorials.

The problems either in the notes, circulated during/prior to class, or given in class (i.e. tutorial sessions) will require either numerical or descriptive answers or explanations. They are specifically designed to consolidate the lecture material, to develop conceptual understanding, to develop problem solving skills, and to help students assess their own progress. Students are encouraged to take ownership of their progress and contact the lecturer if they do not think they are receiving clear and useful feedback, or if they feel that they are struggling with the course material.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Class test and quizzes Assessment Format: Individual	35%	
short oral presentation Assessment Format: Individual	5%	
Lab and lab report (5% each) Assessment Format: Group	20%	
Final Assessment Format: Individual	40%	

Assessment Details

Class test and quizzes

Assessment Overview

One test will take place in August (15%).

A short quiz will take place approx every 2 weeks (5 quizzes for 20% total).

Detailed Assessment Description

During semester, student progress will be assessed with short Moodle quizzes (every 2-3 weeks) to be performed outside of class time. Each quiz will cover all material since the previous quiz is limited to a single attempt of one hour. A 15% Class Test will be held on Monday of Week 6 during the normal lecture time. This will assess all material from Weeks 1-5. Similar to the exam and the quizzes, it will be held on Moodle and contain a range of queston types, including short answer questions requiring the uploading of working.

Assignment submission Turnitin type

Not Applicable

short oral presentation

Assessment Overview

Each student will give a short presentation on a relevant topic of their choosing.

Detailed Assessment Description

Short (~5 min) presentations will be held during the first half of Friday afternoon lectures in Weeks 3, 6, 8, 10 and 13. Students are encouraged to select a topic of broad astrophysical interest. Final topics and the scheduling of individual presentations will be via negotiation with the course convener. Presentations will be assessed for scientific and visual clarity, keeping to time, correct referencing and the ability to answer audience questions, according to the marking rubric on Moodle.

Assessment Length

5 min + questions

Assignment submission Turnitin type

Not Applicable

Lab and lab report (5% each)

Assessment Overview

Four labs will take place throughout the semester. All labs but one can be performed in pairs; all students must hand in their own report for each lab.

Detailed Assessment Description

Labs will take place on Thursday afternoons in Weeks 4, 10 and 13. Lab reports are to be completed in class by the end of each lab. An additional lab exercise (Moon lab) will be performed individually and written up out-of-class hours and submitted through Moodle in Week 7. More information on each lab will be provided at least a week in advance of the scheduled session.

Assignment submission Turnitin type

Not Applicable

Final

Assessment Overview

Final exam to be held in the examination period.

Detailed Assessment Description

A 2-hour computer-based exam will be held during the formal examination period, assessing material from the entire course. The exam will be open book, with the exception of generative AI tools such as Chat-GPT, which are not permitted to be used. The exam will consist of a range of question types, including short answer questions which require the uploading of working.

Assessment Length

2 hours

Assignment submission Turnitin type

Not Applicable

General Assessment Information

The test, quizzes and exam will assess student's knowledge of the course material, their conceptual understanding of the physics involved and their problem-solving skills. We do not condone copying of answers from peers, since this does not help a student to achieve the learning outcomes. We encourage students to remind themselves of the UNSW plagiarism policy, available at https://student.unsw.edu.au/plagiarism.

All marks obtained for assessment items during the session are provisional. The final mark as published by the University following the assessment review group meeting is the only official mark.

Late submission of assessment

Students who miss assessment tasks must contact the lecturer at the earliest practicable date to discuss the absence. If the student provides written evidence (e.g. a medical certificate or a note from a Divisional Officer) of the reason for their absence and the reason for the absence is deemed acceptable by the lecturer, an alternative assessment date may be arranged. Otherwise a zero mark will be awarded for that task. When absences are foreseeable, students must advise the appropriate lecturer or course convener prior to the absence. In some circumstances of missed assessment, a formal application for special consideration may be appropriate. Students must let the instructor know they have submitted a special consideration to avoid mis-communication.

Use of generative AI tools

Generative AI (e.g. Chat-GPT) may not be used in the in-class laboratories, quizzes, the class

test, or the exam. However, some degree of Generative AI is permitted for one of the laboratory exercises (which is a report) at the student's own risk. Please be aware of the associated consequences (outlined below) if generative AI or similar tools are found to be used in a way that violates these guidelines.

Planning assistance is permitted for the Moon lab: As this assessment task involves some planning or creative processes, you are permitted to use software to generate initial ideas. However, you must develop or edit those ideas to such a significant extent that what is submitted is your own work, i.e. only occasional AI generated words or phrases may form part of your final submission. If generative AI software is used in helping you to prepare this assessment, then you are required to submit the original AI-generated responses as screenshots with your report. If the outputs of generative AI such as Chat-GPT form a part of your submission, it will be regarded as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion. Note that generative AI is not required for this assessment; its use is fully up to the discretion of the student.

Grading Basis

Standard

Requirements to pass course

The assessment for the course has been designed so that an overall mark of 50% or greater indicates that the student has unambiguously demonstrated satisfactory completion of each learning outcome. For this reason, and consistent with the UNSW policy of abolishing the Pass Conceded grade, students who receive less than 50% overall for the course will receive a fail grade.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Lecture	Astronomy fundamentals (parallax, coordinates, magnitudes, diffraction), the hydrogen atom
Week 2 : 22 July - 26 July	Lecture	The physics of spectra (excitation), Planck function, blackbodies, equilibrium temperature
Week 3 : 29 July - 2 August	Lecture	Optical depth, Boltzmann and Saha equations, Doppler effect
Week 4 : 5 August - 9 August	Lecture	The Sun and stellar properties, virial theorem
	Laboratory	Stellar spectra
Week 5 : 12 August - 16 August	Lecture	Stellar evolution, HR diagrams, scaling relations, star clusters
Week 6 : 19 August - 23 August	Lecture	Free-fall time, Jeans mass, AGB stars, degeneracy, white dwarfs.
	Assessment	Class Test (15%)
Week 7 : 9 September - 13 September	Lecture	Binary stars, eclipsing binaries, exoplanets
Week 8 : 16 September - 20 September	Lecture	The Milky Way, rotation curves, dark matter
Week 9 : 23 September - 27 September	Lecture	Galaxy types, galaxy formation/AGN, Tully-Fisher and Faber-Jackson relations
Week 10 : 30 September - 4 October	Lecture	Cosmological observations
	Laboratory	Eclipsing binaries
Week 11 : 7 October - 11 October	Other	No lectures due to Labour Day and Military Training Days
Week 12 : 14 October - 18 October	Lecture	Friedmann equation, redshift re-visited
Week 13 : 21 October - 25 October	Lecture	Evolution of the Universe, Big Bang, nucleosynthesis, cosmic microwave background
	Laboratory	Hubble's Law

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings. Students are indeed expected to attend all lectures, tutorials, laboratory sessions and assessments unless their absence has been approved by the course coordinator. Students who have missed assessments or a laboratory, or expect to miss such a requirement, must inform the course coordinator by email at the earliest practicable date. In typical circumstances of missed assessments, a formal application for Special Consideration via the prescribed University procedure may be appropriate. Alternative assessment can then be arranged. Otherwise, in the case of absence a mark of zero will be awarded for the assessment. Further information is available under 'Assessments'.

General Schedule Information

The course comprises three hours of lectures per week, one dedicated tutorial per week, and four laboratories during the semester. A detailed schedule of lecture topics and assessments is provided on Moodle.

Students are expected to prepare for classes through the study of course notes, textbooks, other

materials available via Moodle, weekly problem sets, the library and internet resources. We expect students to spend at least as much time on individual studies as they spend in class. In addition, meeting regularly with a study partner or a small study group is also known to be effective. It is expected that students will review each lecture in their own time, shortly after the lecture has been delivered, so that difficult concepts can be identified and assistance sought it required. Lecture slides will be posted on Moodle in advance, but it is expected that students will use more than one source in their study (e.g. textbook).

Course Resources

Prescribed Resources

The prescribed textbook for this course is *'Astrophysics in a Nutshell'*, 2nd ed., 2016, by Dan Maoz, published by Princeton University Press. The book is available for purchase from the publisher or several well-known online retailers.

A scientific calculator without stored memory is required for this course, and should be on hand during class time especially during tutorials and quizzes/tests. A Casio fx-82AU (or similar) calculator can be used during the class test and exam. In general, calculators permitted in earlier maths and physics courses will be acceptable. Questions regarding the suitability of a particular model should be directed to the course convener in advance of these assessments.

Recommended Resources

Recommended readings:

Carroll and Ostlie's *'An Introduction to Modern Astrophysics'* is available at the UNSW Canberra library and purchase online. It offers a comprehensive treatment of all of the topics covered in this course.

In addition, the e-book *'Understanding Stellar Evolution'* by Lamers and Levesque is an excellent, modern, free resource and will be referred to frequently.

Another useful resource is *'Astronomy 2e on OpenStax'* by Fraknoi, Morrison, and Wolff, also available online.

Course Evaluation and Development

Students will be asked to complete the myExperience survey towards the end of this course. Students can also provide feedback during the semester via direct contact with the lecturer, the

“On-going Student Feedback” link in Moodle, via class representatives to the School of Science's Student-Staff Liaison Committee and informal feedback conducted by teaching staff. Refer to the Moodle site for this course to see how the feedback from previous students has contributed to the course's development.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Simon Murphy		Building 26, Room 118 (upper level)	(02) 5114 5187	Available for walk-in consultations, or email for an appointment	No	Yes