Physics and Astronomy
School of Physical and Chemical Sciences

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

General Course Information

ASTR112 – Astrophysics

0.125 EFTS 15 Points First Semester

Staff

Lecturer (Sun and Stars) and Coordinator:
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Lecturer (Planets and Exoplanets):
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Lecturer (Galaxies and Cosmology):
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Tutors for laboratories and tutorials (to be confirmed):

Course Description

ASTR112 Astrophysics is a 15-point course offered in the first half of the year and designed to give students a general introduction to modern astronomy emphasizing the important physics. The level of the lectures is essentially descriptive with some mathematics and involves discussion of the relevant principles of physics.

Goals of the Course

- Provide foundation knowledge of Astrophysics for students advancing in an astronomy or physics BSc or BSc(Hons) degree.
- Illustrate key concepts in physics using the medium of astronomy, where the Universe becomes our laboratory for studying physics at extreme scales.
- Give students experience of analysing and solving astrophysical problems, and in basic astrophysical data analysis.

Learning Outcomes

Students will:

- Have developed and be able to demonstrate basic scientific competency to solve appropriate problems in basic astrophysics.
- Have developed and be able to demonstrate basic astrophysics data analysis skills using software designed to simulate astronomical observations.
- Have developed and be able to demonstrate written communication skills.

Pre-requisites

R: A background in physics and mathematics to at least NCEA Level 2 is desirable. Most students will have taken these subjects at NCEA Level 3.

Course Assessment

10% homework: 5 problem-solving homework assignments
20% computer laboratories: 5 written reports on computer laboratories
15% Mid-semester Test, 1 hour.
55% Final Examination, 3 hours.

Mid-term test

The test will cover material from the first part of the course (The Sun and Stars) and will comprise 15% of the final mark. The time and location for the test will be updated on your timetable closer to the time of the test.

Lectures

The course comprises three lectures per week during the first semester (Terms 1 and 2). You should check your personal timetables at https://mytimetable.canterbury.ac.nz/aplus/apstudent for scheduling of lecture times/venues.

Summary of Course Content

Sun and Stars
How can we study the stars? Characteristics of electromagnetic radiation and matter. The Sun and how it shines. Distance to stars. The Hertzsprung-Russell diagram; Internal stellar structure; Stellar Evolution; protostar to stellar death – white dwarfs, planetary nebulae, supernovae, neutron stars and black holes.

Planets and Exoplanets
How do we think planets form, and how do we explain the origin of our own solar system? Ways of finding planets and the search for life on other worlds.

The Milky Way Galaxy
How do we observe the Galaxy? The effects of cosmic dust and the nature of the interstellar medium. Star formation, spiral structure. Galactic rotation and evidence for Dark Matter. The centre of the Galaxy and supermassive black holes.

Galaxies and Cosmology
Galaxies beyond the Milky Way; Hubble's law and the distance scale; Large-scale structure of the Universe; Active galaxies and quasars; Cosmology – Big Bang & beyond; Dark Energy.

Computer Laboratories and Problem-Solving Skills Tutorials

As well as lectures, there will be a session that alternates between paper-based problem-solving skills tutorials and computer-based astronomy laboratory exercises.

In the first week, the session will run as an active tutorial where students can discuss course material with teaching staff (lecturer and tutors) and where staff will go through and assist students in attempting astrophysical problems similar to those on the homework sheet and at the level that you will encounter in the test and exam. Homework will be on LEARN at the start of the week and can be attempted during the tutorial and tutors can be asked for help at this time. The homework (5 in total, 4 of which are assessed) will carry 10% of the total mark. The first homework will be formative – you should attempt it and check the model answers to see how well you did, but it will not be formally assessed.

The computer labs will run in the alternate weeks. They make use of the CLEA software, which simulates astronomical observing projects, and other web-based astronomy activities. These are expected to take about 3 hours to complete in total. You will have one week to complete each assignment, and there are 5 in total; 4 are assessed, giving 20% of the final mark. You will have the time with teaching staff in the computer lab to start the assignment and to make sure that you understand the aims and that you can use the software.

Computer Laboratory/Tutorial Timetable

Session	Monday Date	Activity	Assessment due
Term 1			
Week 1	17 Feb	Tutorial 1	
2	24 Feb	Computer lab 1: Solar rotation	HW1 not assessed
3	2 Mar	Tutorial 2	Lab 1
4	9 Mar	Computer lab 2: Stellar spectra	HW 2
5	16 Mar	Tutorial 3	Lab 2
6	23 Mar	Revision	HW 3
7	30 Mar	Computer lab 3: Agent exoplanet	none
Term 2			
8	27 Apr	Tutorial 4	Lab 3
9	4 May	Computer lab 4: Hubble's Law	HW 4
10	11 May	Tutorial 5	Lab 4
11	18 May	Computing lab 5: Cosmology	HW 5
12	25 May	Revision	Lab 5

Textbooks

Recommended Textbooks:

- Green and Jones: Introduction to the Sun and Stars (Cambridge University Press, 2015, 2nd edition).
- Jones and Lambourne: Introduction to Galaxies and Cosmology (Cambridge University Press, 2015, 2nd edition)

Numerous other astronomy texts suitable for supplementary reading are available in the Engineering and Physical Sciences Library.

General Physics and Astronomy Information

Please consult the document General Information for Physics and Astronomy Students on the Physics and Astronomy Web Page:

http://www.phys.canterbury.ac.nz/courses/General.pdf