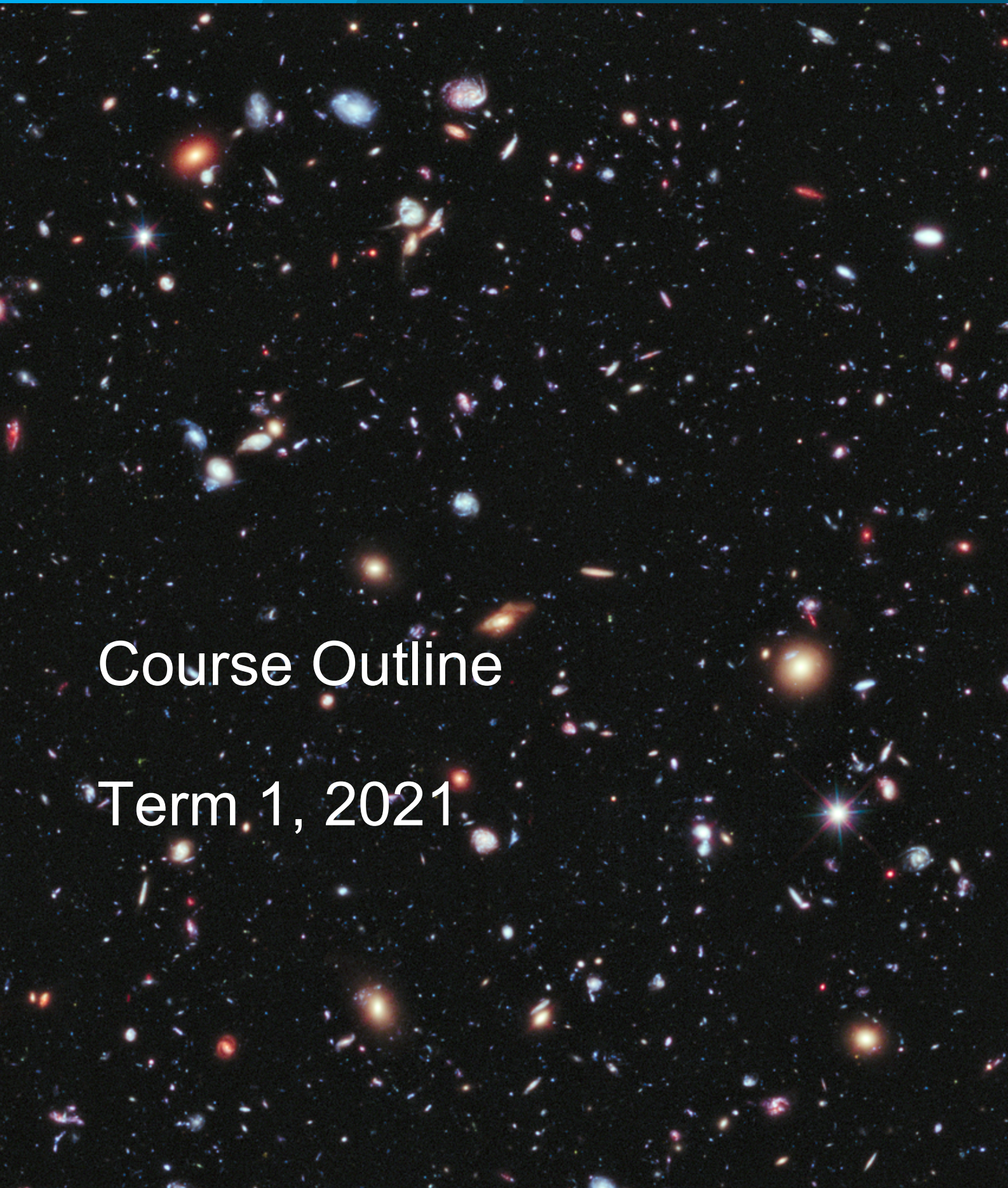
PHYS 1160 - Introduction to Astronomy and the Search for Life Elsewhere

Never Stand Still | Science | School of Physics



Course Outline

Term 1, 2021

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Important Information

The course operates entirely online through Moodle. Log in at:
https://moodle.telt.unsw.edu.au/login/index.php

Course Staff

Course Editor (Moodle queries):
A/Prof Kim-Vy Tran (T1 2021)

Course Facilitator (Course materials):
Prof Michael Ashley (T1 2021)

Teaching Assistants:
A teaching assistant is assigned to each group for this course. See the "Course Discussion Groups and Tutors" link on the Moodle page for PHYS1160 for a list.

Assessment

- Activities (30%) — The 20 course activities (interactive tutorials) are graded and provide 30% of your final grade.
- Discussion Group Participation (25%) — from contributions to the five module discussions (Module 1, Module 2, Module 3, Module 4, and Module 5).
- Article (20%) — You must write an article based on provided information – due 18 April (i.e., at the end of week 9).
- Final Exam (25%) — The final test will be an online test set on the course website in Moodle covering material throughout the course (date to be announced during the course).

About the Course

One of the first things you will notice about this course is that there are no lectures. Instead, course material is provided in the form of online Lessons. These are made of a mix of multimedia material including text and images, videos, animations and simulations. You can step through them page by page, you can display a whole lesson as a single webpage, and you can print them to provide a hardcopy record of the whole course.

Associated with each lesson is an interactive tutorial, called an Activity, which will take you step-by-step through aspects of the course content. Activities include videos and simulations and will set you problems based on these. Most questions in the Activities are graded. Don't think of the Activities as simply tests of what you covered in the lesson. They may well extend the material covered in the lessons, and require further research in the textbook, or on the internet.

Another key part of the course is the discussion forums. Your contributions to the discussion will be graded. In each of the five discussions (Module 1, Module 2, Module 3, Module 4, and Module 5) you are expected to post at least one question, and one answer to another student's question. We are particularly looking for well-researched answers supported by references. The skills used here will also be valuable when you come to write your article, which will be due at the end of week 9 of the course.

An important thing to understand about this course is that it is not about memorizing a lot of facts that you will be subsequently tested on. There is far more material covered in the course than you can expect to remember. What we do hope you will do is develop an understanding of the basic concepts and ideas.

Remember that all assignments in this course including the final exam are "open book". When you are working on the assignments you have access to all the resources including the course lessons, the textbook, and the internet. You need to learn how to use these resources efficiently to find whatever information you need.

Learning Outcomes

On completion of the course you should:

1. have an understanding of key recent developments and concepts in areas including astronomy, space exploration, astrobiology and related disciplines,
2. appreciate the interrelatedness of different scientific disciplines,
3. understand the scientific method, what it means to study something scientifically, and the process of scientific discovery,
4. know that science is a continuing international endeavour, and that scientists are diverse in age, gender, ethnic background and nationality,
5. be competent in using resources on the internet to investigate scientific questions, and in preparing written reports on such investigations.

Keeping In Touch

General questions about how the course operates are best asked through the course discussion forum near the top of the Moodle main page. That way everyone gets to see the answers. Before you ask, though, please check the course information, course FAQs and course discussion. The answer may already be there.

If you want to contact a specific member of the team you can do this through Moodle messaging or through email.

Who to contact:

Contact your group teaching assistant for feedback on marks and marking for the tutor marked assignments (discussions, essays). If you are not sure who your teaching assistant is, use "**Participants**" on Moodle and select "Teaching Assistant" in the "Current Role" drop-down menu. You can click on the name to send a Moodle message, or choose "User Details" under "User list" to find the email address.

For other queries contact the course facilitator or the course editor. Check the School of Physics website for more details.

For administrative matters such as enrollment issues you can contact the Physics First Year Teaching Unit (Old Main Building G06) via phone (9385 4976) or email (UNSW.to/webforms).

Extensions for Assignments:

If you are unable to complete an assignment on time due to illness or other circumstances, then make sure submit a "Special Consideration" request through the centralized UNSW Special Consideration system. Such requests should be submitted no later than 3 days after the assignment deadline. If you know something is coming up in advance (e.g., overseas travel), then make sure to submit a request in advance.

Note that UNSW now has a "Fit to Sit / Submit" rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. More about what this can be found at the Special Consideration link above.

Grades

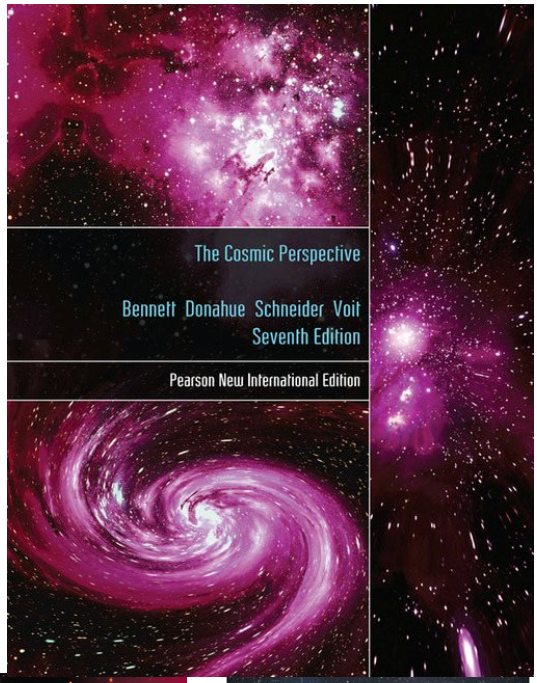
Your grades will appear under **Grades** at the left of your Moodle page as each assignment is marked.

Course schedule

Week	Lessons/ Activities	Discussion Group	Textbook sections	Assignments
1-2	Module 1 Introduction to Astronomy Lessons 1-4	Module-1 15 – 28 February	Chapter 1, 3, 4, 5, 6	Module 1 discussion final date 28 February
				Activities 1-4 complete 28 February*
3-4	Module 2 The Solar System Lessons 5-8	Module-2 01 – 14 March	Chapter 7, 8, 9, 10, 11, 12	Module 2 discussion final date 14 March
				Activities 5-8 complete 14 March*
5-6	Module 3 Life on Earth and in the Solar System Lessons 9-12	Module-3 15 – 28 March		Module 3 Discussion final date 28 March
				Activities 9-12 complete 28 March*
				Article draft due 28 March
7-8	Module 4 Stars and Stellar Systems Lessons 13-16	Module-4 29 March – 11 April	Chapter 13, 14, 15, 16, 17, 18	Module 4 discussion final date 11 April
				Activities 13-16 11 April*
9-10	Module 5 Galaxies and Cosmology Lessons 17-20	Module-5 12 – 25 April	Chapter 19, 20, 21, 22, 23	**Article due 18 April**
				Module 5 discussion final date 25 April
				Activities 17-20 complete 25 April*
	Final Test			**Final Test (date/time TBA)**

All submission dates are **Sunday before midnight – except for the Final Test, which is due at a date and time to be announced on Moodle**.
* Completion dates for activities are suggested completion dates to keep on track with the course. **All activities must be completed by 02 May 2021**.

Textbook



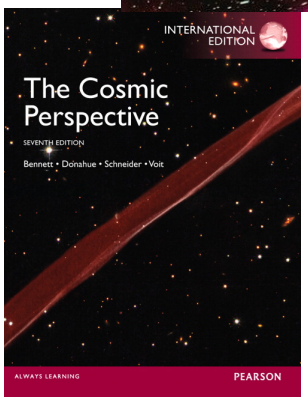
The recommended textbook for the course is **The Cosmic Perspective**, by Bennett, Donahue, Schneider & Voit, Seventh Edition, Pearson New International Edition.

ISBN: 9781292023304
Publisher: Pearson Higher Ed USA

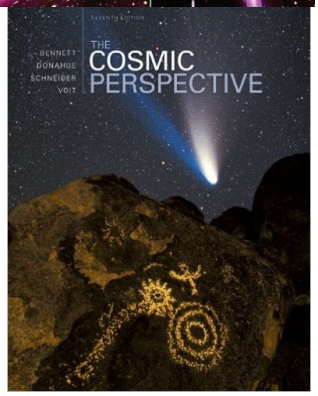
Where to get it:

1. From the UNSW Bookshop – copies are available.
2. Online from Pearson Australia as an eBook ($60). The hardcopy is no longer available direct from Pearson (https://pearson.com.au/9781292023304).
3. The UNSW library has multiple copies in the High Use Collection.

If you are looking at secondhand books or other online suppliers you may find other versions of **The Cosmic Perspective 7th, 8th, or 9th editions**. Any of these are fine. They all contain the same content but may have minor differences of formatting so page numbers may not exactly match.



International Edition



US Edition

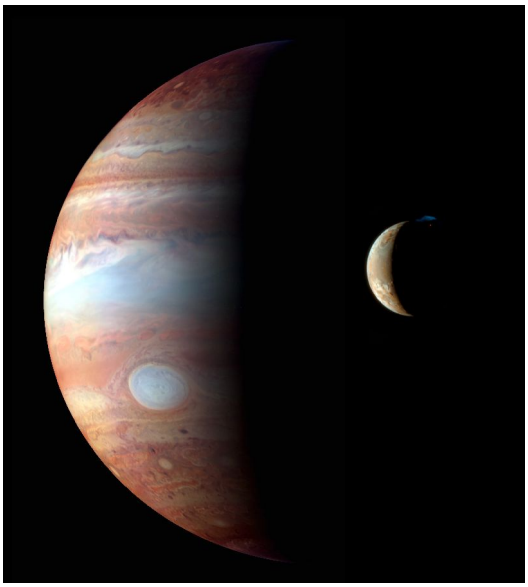
For example, this book had an 8th edition issued in the US in 2017, and a 9th edition has been released in 2019. (These are available as both a single volume, and as two separate volumes, and in e-text formats). The 9th edition is now available as a book in Australia, it is also available as an eBook (https://pearson.com.au/9780135161760).

Older editions of the book such as the sixth or fifth edition will obviously not be quite as up to date as the current version, but still retain the same chapter structure and much of the same material, so should be useable for this course.

You may come across ***The Essential Cosmic Perspective.*** This is a different book – an abridged version with fewer chapters. You may also see versions of the 8th and 9th editions that have been split into two halves – it is suggested you avoid buying these versions. The Cosmic Perspective sometimes comes bundled with software products such as Pearson's Mastering Astronomy. This software is not used for our course.

Another book you may find useful is **Life in the Universe** by Bennett & Shostak, (Pearson Higher Ed. ISBN 9780134089089). This provides better coverage of the Astrobiology aspects of the course.

Modules



Module 1 — Introduction

Lesson 1 — Introduction to Astronomy
The components of the universe (stars, planets and galaxies), the scale of the universe, a brief historical guide to the study of astronomy.

Lesson 2 — Introduction to Astrobiology
Why life might be common or might be rare. The science of astrobiology. Where and how can we search for life in the universe?

Lesson 3 — Key Concepts
Forces and Energy, Gravity, Orbits and Kepler's laws. Atoms and nuclei. Light and other electromagnetic waves.

Lesson 4 — Techniques of Astronomy
Telescopes and instruments for different wavelength regions. Observing methods. Spectra and the Doppler shift.
Effect of the atmosphere. Observations from space.

Module 2 — The Solar System

Lesson 5 — The Solar System
Introduction to the solar system. Terrestrial and giant planets, satellites, dwarf planets., small solar system bodies. The formation of the solar system.

Lesson 6 — The Earth – Evolution of a habitable planet
Formation of the Earth and Moon. Age of the Earth. The heavy bombardment. Plate tectonics. Formation of oceans and continents. Evolution of the atmosphere. The faint-young Sun paradox and its resolution.

Lesson 7 — Exploring the Solar System
Getting to a planet. Types of space missions. The key planetary exploration mission and what we have learnt from them. Ground-based studies of the planets.

Lesson 8 — Habitability in the Solar System
Definition of a habitable planet. Follow the Water. Past water on Venus. Evidence for water on Mars in the past and now. Evidence for oceans beneath the ice of Jupiter's moons and Enceladus.

Module 3 — Life on Earth and in the Solar System

Lesson 9 — What is Life?

Properties of life. Classification of living organisms, Evolution and heredity. The molecular basis for life, DNA, RNA and proteins.

Lesson 10 — The History of Life on Earth

Methods for studying life's history. The fossil record. The earliest evidence for life. Molecular methods and the "tree of life". Extremophiles. Life and the Earth's atmosphere.

Lesson 11 — The Origin of Life

Historical ideas on life's origin. The fundamental problem. The RNA World. Possible pre-RNA worlds. Origin of the building blocks of life. The timing of life's origin relative to the late heavy bombardment. Could life have come from another planet?

Lesson 12 — Life in the Solar System

Ideas on life on Mars. Percival Lowell's canals. Early Mars missions. The Viking missions. The Martian meteorite ALH84001. Methane on Mars, Future Mars missions. Life on the giant planet moons and how we could search for it.

Module 4 — Stars and Stellar Systems

Lesson 13 — Our Star, the Sun

The Sun's energy source. Nuclear fusion. Structure of the Sun. Solar activity. The Sun-Earth connection.

Lesson 14 — Properties and Evolution of Stars

Properties of stars. Spectroscopic classification. The Hertzsprung-Russell diagram. Types of stars. Evolution of low and high mass stars. Multiple stars. Star clusters.

Lesson 15 — Extrasolar Planets

Detection of exoplanets. Doppler, transit, microlensing methods. Types of and properties of exoplanets (e.g. hot Jupiters, eccentric planets). Comparison with our solar system.

Lesson 16 — Habitability and life on exoplanets

The problem of directly detecting exoplanets. Direct detection methods (giant ground-based telescope. nulling interferometers, coronagraphs, Occulters). Signatures of habitability. Biosignatures.

Module 5 — Galaxies and Cosmology

Lesson 17 — Our Milky Way Galaxy

Size and structure of the Milky Way. The disk, bulge and halo. Orbits of stars. The galactic centre.

Lesson 18 — Recycling of Material in the Galaxy

The interstellar medium. Molecular clouds. Star formation. Planetary nebulae. White Dwarfs. Supernovae. Neutron stars and black holes.

Lesson 19 — Galaxies and their Evolution

Types of galaxies. Distances of galaxies. Looking back in time. The Hubble deep field. Galaxy formation and evolution. Active galaxies and quasars.

Lesson 20 — Cosmology

The expanding universe and Hubble's law**.** The Big Bang theory. The cosmic microwave background. Dark matter and the evidence for it. The accelerating universe and dark energy, The standard model of the universe.