ANU EXTENSION

ASTROPHYSICS – ANU

H COURSE

B S S S AUSTRALIAN CAPITAL TERRITORY	**Course Adoption Form for Accredited Courses**

University: Australian National University				
Course Title: Astrophysics - ANU	**Classification: H**			
Framework:	**Course Area:**		**Course Code:**	
Dates of Course Accreditation:	**From**	**2016**	**to**	**2020**

Identify units to be adopted by ticking the check boxes

Adopt	Unit Title	Value (1.0/0.5)	Length
☐	Planets, Stars and Black Holes	1.0	S
☐	Cosmology	1.0	S

H Classification: The course and units named above are consistent with H course policy and are signed on behalf of the BSSS.

Principal: / /20	College Board Chair: / /20

BSSS Office Use
Entered into database: / /20

Contents

Course Name

Astrophysics ANU

Course Classification

H

Course Developers

Name	Qualifications
Paul Francis	PhD; Astrophysicist, Mt Stromlo Observatory & Physics Education Centre, ANU
Brian Schmidt	PhD; Astronomer, Research School of Astronomy and Astrophysics, ANU

This group gratefully acknowledges the contributions of John K See.

Course Length and Composition

The definition of a unit and hour requirements for a standard unit and course duration, as outlined in policies 3.2.9 Unit, 3.2.9.1 Unit Values and 3.2.8.3 Course Duration (2015 BSSS Policy and Procedures Manual), apply to H courses.

Name and Number of Units Submitted and the Length of the Units expressed as a Value

Unit Title	Unit Value
Planets, Stars and Black Holes	1.0
Cosmology	1.0

Available Course Patterns

Course	Minimum number of hours per course	Number of standard 1.0 value units to meet course requirements
Minor	110 hours	2 units of 55 hours

Implementation Guidelines

Students would generally be expected to be enrolled in both **Physics** and at least **Mathematics Methods** at their home college.

Contribution towards an ATAR

Students can count up to 2 H courses to a maximum weight of 1.2 (equivalent to 2 minors) out of the required 3.6 in the calculation of the ATAR.

A maximum of 4 standard units from H courses can contribute to the minimum requirements for an ACT Senior Secondary Certificate and Tertiary Entrance Statement.

Reporting of H courses on the ACT Senior Secondary Certificate

Home college and H courses are reported separately, each with its own course type.

A ‘T’ classified major minor and ‘H’ minor in the same subject are equivalent to a double major course type.

Goals

These goals focus on the essential concepts and skills that students should know and be able to do as a result of studying Astrophysics ANU. They are intended student outcomes. This Astrophysics ANU course should enable students to:

- Describe the major features of the universe and their origin
- Demonstrate familiarity with the main outstanding research problems in contemporary astrophysics
- Apply the main research techniques of modern astrophysics
- Interpret astrophysical data and model astrophysical objects
- Produce a structured report on astrophysical investigations.

Student Group

This course is designed for students who wish to study modern astrophysics at a high level and who have a desire to gain a deep understanding of the universe and its evolution. Students apply to ANU for entry to this course and suitable applicants are selected at the beginning of their Year 11 year through a selection process. This process may include some or all of; a selection test, evidence provided of past academic successes, school/college recommendation.

A student who achieves a satisfactory standard in this course will be made an early offer of entry to the ANU. The offer will be for the BSc or BSc Hons or PhB course depending on the level of achievement. A pass in this Astrophysics ANU course is not a guarantee of an early offer. Early offers are decided by the ANU Dean of Sciences, students who are made early offers will also be awarded a six-point credit towards an ANU undergraduate Science course.

Assessment

The following criteria are a focus for assessment and reporting in this course. Criteria are the essential qualities that teachers look for in student work.

Students will be assessed on the degree to which they demonstrate:

- Knowledge and understanding of the origin and structure of the universe
- Understanding of the nature of the relevant astrophysical data
- Application of appropriate tools to analyse data
- Critical analysis
- Effective communication
- Assessment tasks will be consistent with the assessment requirements of the BSSS Science Course Framework endorsed 2014. There will be 3 – 5 summative assessment items for a 1.0 point unit and 2 – 3 for a 0.5 point unit. Weighting of assessment tasks will be consistent with the framework recommendations (below).

There will be 4-6 assessment tasks for a 1.0 unit and 2-3 for a 0.5 unit.

Task Types	Student Investigations	Tests
The following examples are a guide only	Logbook Prac Report Scientific Poster Research Assignment Seminar / Oral / Electronic presentations Project Essay Models	Unit tests Practical skills test Quizzes
Weighting (most units)	40 – 60 %	40 – 60 %
Weighting (project based units)	60 – 100 %	0 – 40 %

Moderation

9.2.2 Moderation of H courses (2015 BSSS Policies and Procedures Manual)

Teachers of H courses will be required to present portfolios of student work for verification that units are taught and assessed as documented. The Moderation Officer should report any concerns to the Board.

A Year 11 review portfolio will be prepared in December, after the end of the first 1.0 point unit, for Moderation Day 1 the following year.

A Year 12 review portfolio will be prepared by Week 3, Term 4 following the completion of the Year 12 unit at the end of Term 3.

Review portfolios will present the work of two students at different grade levels.

Grades in H courses are not subject to moderation.

Bibliography

Recommended Texts

An Introduction to Modern Astrophysics (2nd edition, 2006): B. W. Carroll & D. A. Ostlie, Addison-Wesley

An Introduction to Modern Cosmology (2nd edition, 2003), A. Liddle, Wiley

How to build a habitable planet (revised version 2012), C. H. Langmuir & W. Broecker, Princeton University Press

Exoplanets: Finding, Exploring and Understanding Alien Worlds (Astronomers' Universe) (2011), C. R. Kitchen, Springer.

These were accurate at the time of publication.

Planets, Stars and Black Holes Value 1.0

Specific Unit Goals

This unit should enable students to:

- Use Newtons laws to analyse motions in space
- Plot data, and interpret data presented in the form of graphs
- Describe the timing of the major events of the evolution of the universe, from the formation of the first stars to the present day
- Describe the origins of the elements
- Describe the formation of the solar system
- Apply an understanding of the conditions of the universe to life in space
- Describe the information and processes that lead to the discovery of extrasolar planets
- Solve complicated problems based on simulated data sets.
- Produce properly planned and constructed reports.
- Understand and articulate the scientific method as applied in contemporary astrophysics.

Content

This unit is designed for students who wish to study modern astrophysics at a level beyond most popular books and in greater depth to that which exists in most college Physics courses. It covers

- The main time, length and mass scales in astronomy
- The application of Newtons laws in astrophysics
- The first stars in the universe
- Supernovae, black holes and the death of stars
- The formation stars and planets
- Methods for finding new planets and conclusions that can be drawn from them
- Planetary climates and thermodynamics
- Life in space – philosophical arguments about its existence and nature
- The use of graphical methods to display astrophysical data
- An introduction to statistical techniques used in astrophysics
- The acquisition of data concerning the universe

Teaching and Learning Strategies

Predominately all lectures will be provided on-line using the edX platform. They will consist of a series of short video clips interspersed with formative assessment tasks.

These videos will feature senior ANU astrophysicists, who will from time to time be available via chatroom and in the classroom. In addition there will be regular on-line homework, and on-line laboratories. The course coordinator will monitor student progress to ensure that the required student course participation time is met.

A major learning strategy is the use of computer-based simulations that will require students to interact with large amounts of data to discover facts about a simulated universe, which may or may not be the same as ours.

Students will also be required to work collaboratively on these simulated universe exercises.

Assessment

There will be 4-6 assessment tasks for a 1.0 unit and 2-3 for a 0.5 unit.

Tasks Types	Student Investigations	Tests
The following examples are a guide only	Log book Prac report Scientific poster Research assignment Seminar/Oral/Electronic presentations Project Essay Models	Unit tests Practical skills test Quizzes
Weighting (most units)	40 – 60%	40 – 60%
Weighting (project based units)	60 – 100%	0 – 40%

Specific Unit Resources

In addition to online materials developed specifically for this course

Recommended Text

Book

Tipler, P. A. and Mosca, G. *Physics for Scientists and Engineers,* W. H. Freeman and Company, New York

This was accurate at the time of publication.

Cosmology Value 1.0

Specific Unit Goals

This unit should enable students to:

- Use statistical tools to filter, display and interpret data
- Describe the major sources of electromagnetic radiation in the universe
- Describe the nature of, and relationship between dark matter, dark energy, and the expanding universe
- Apply the theory of general relativity to the expanding universe
- Use information technology to access information about the universe, simulated or real, and filter this information to reveal factual information
- Synthesise information related to astrophysics from a variety of sources and present a properly planned and constructed report.
- Understand and articulate the scientific method as applied in contemporary astrophysics.
- Produce properly planned and constructed reports.

Content

As for the previous unit, this unit is designed for students who wish to study modern astrophysics at a level beyond most popular books and in greater depth to that which exists in most college Physics courses. It covers

- The origins of electromagnetic radiation and the various categories of electromagnetic radiation
- The very early universe, from the era of inflation to the microwave background
- The expanding universe, and evidence for the Big Bang
- Dark matter: the evidence for it, alternative theories and its possible nature.
- Dark Energy, the evidence for it, alternative theories and its possible nature.
- The information base on which an interpretation and description of the universe depends
- The science required to interpret the information gathered to describe the universe, to include general relativity
- The acquisition of data concerning the universe
- The use of information technology to process large data sets
- The use of statistical techniques to analyse large data sets

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