

# **Astronomy by Distance** **Learning**

## **Module Catalogue**

**Updated June 2010**

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<b>Module Title:</b>	<b>Introduction to Astronomy</b>		
<b>Module Code:</b>	<b>AA1051</b>	<b>Module Level:</b>	1
<b>Module Tutor:</b>	Anne Sansom/ Barbara Hassall	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	None	<b>Semester:</b>	Year (DL) Sem 1 (Campus)
<b>Co-requisites:</b>	None		

### ***Module Aims:***

This module presents a broad introduction to the subject of astronomy including observational and practical techniques and report writing skills as well as theoretical aspects. No prior knowledge of astronomy is necessary and students may undertake this module with a limited background in physics and mathematics. The module provides an informed view of concepts in astronomy which are discussed in terms of the underlying physics. Therefore students are normally expected to have GCSE mathematics or equivalent and experience of GCSE physics is advantageous. It is suitable for distance learning students who have a strong desire to learn about the subject at first year university level, including teachers, members of astronomical societies and those seeking study for their own personal development, or for on-campus students, as the first step towards degree-level study of astronomy.

### ***Syllabus and Content:***

The course covers a substantial number of topics from:

#### **Introduction**

Astronomy as an observational science, fundamental naked-eye observations, time, seasons, coordinates, optical telescopes, the electromagnetic spectrum, modern observing platforms.

#### **Stars**

The measurement of stars. The observational Hertzsprung-Russell diagram and the basic properties of stars, the Sun as a star. Binary stars. Nuclear energy generation in stars and a descriptive overview of stellar structure. Overview of stellar evolution and its late stages. An overview of the Milky Way Galaxy.

#### **Galaxies and the Universe**

The extragalactic distance scale and expansion of the Universe. Galaxy morphology and classifications, spiral structure, rotation curves and dark matter. An introduction to cosmological models and the origin of the Universe.

#### **Laboratory Work**

Laboratories are a combination of indoor activities and outdoor observing. The exact mix will depend on the observing seasons.

**Activities include:** Use of telescopes; coordinate systems and time; Observing the moons of Jupiter and using them to deduce the mass of Jupiter; photography; Photography and analysis of the moon's surface structure; Schmidt Plate Investigation; Computer Assisted Learning Packages; stellar classification; Plotting a Hertzsprung-Russell diagram for stars.

### ***Teaching and Learning Strategy:***

This module may be studied by distance learning or as an on-campus lecture course.

Both modes of study present the student with the appropriate subject knowledge and activities. The activities are designed to illustrate and elucidate subject material, as well as giving students the opportunity to gain experience in the acquisition and handling of scientific data.

- **Distance Learning students** will learn via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule. Each student will receive a distance-learning package including: *Astronomy Course Notes* and *Astronomy Workbook*. The *Course Notes*, which are closely linked to a course textbook, will be based around how we use observations, coupled to basic physical principles, to understand the phenomena of the Universe. The *Workbook* contains the assessed coursework, self-test exercises, guidance on practical observations and scientific report writing. Materials are provided on CD-ROM and a Personal Computer is required. Access to the Internet would also be an advantage. Tutorial support will be provided by e-mail, on-line discussion groups (e.g. via the website and WebCT) and telephone. It is not necessary to have access to a telescope or binoculars to complete this course. Activities include indoor exercises and outdoor observation that require no specialist equipment. An *optional weekend* at Alston Observatory includes hands-on work with telescopes and the use of astronomical resources at Alston Observatory. Priority is given to weekend participants without home access to a telescope or photographic equipment.
- **On-campus students** will learn mainly in the classroom through lectures, teaching sessions and tutor led discussions. Some private study will also be necessary to supplement the classroom sessions. Subject material will be provided as a mixture of formal lectures and material used for the DL delivery. These students will have regular tutorials in the classroom and will also be able to participate in the on-line discussion forums. On-campus students will have the opportunity to use Alston Observatory one night per week over one semester.

### ***Learning outcomes:***

On successful completion of this module, students will be able to:

1. describe or define concepts and astronomical terms from the syllabus and so demonstrate a knowledge of basic astronomical concepts
2. solve elementary problems in basic astronomy
3. demonstrate elementary skills in observation, measurement, log keeping and data analysis
4. demonstrate elementary laboratory report writing skills
5. summarise simple scientific information and concepts and draw conclusions. (eg following a laboratory experiment or observation)

### ***Assessment Strategy:***

Assessment will be by coursework only and there is no examination. There are four equally weighted items of coursework normally consisting of

- two question sheets covering the syllabus. Each is a balance of descriptive questions and simple problems

- two activities involving practical/experimental techniques and scientific report writing.

<i>Component</i>	<i>Typical Weighting</i>	<i>Assessed learning outcomes</i>
(1,2) Question sheets	2×25%	1,2
(3,4) Experimental reports	2×25%	3,4,5

It is not necessary to pass each item of coursework individually provided that at least one question sheet and one Workbook Activity has been attempted and the overall module mark is 40% or more.

### ***Bibliography and Learning Support Material:***

*Astronomy Workbook* and *Astronomy Course Notes* for Distance Learning, CDRom.

WebCT server: Elearn.uclan.ac.uk

Distance Learning Website: <http://www.studyastronomy.com>

### **Recommended textbook:**

Currently the notes are based on *Universe* 9<sup>th</sup> edition and hence this text is essential for distance learning.

R.A.Freedman, W.J. Kaufmann III and R. Geller (2010) *Universe* 9<sup>th</sup> edition, W H Freeman, (paperback).

### **Suggested further reading:**

Norton, A.R *Norton's Star Atlas and Reference Handbook*, Pitman Pub. (any recent edition)

Students intending to continue on a defined field route will find a more mathematical introduction to astronomy in:

Karttunen, H., Kroger, P., Oja, H., Poutanen, M. and Donner, K.J (Eds), (2007) *Fundamental Astronomy (5th Edition)*, Springer Verlag. (paperback).

<b>Module Title:</b>	<b>Introduction to Cosmology</b>		
<b>Module Code:</b>	<b>AA1053</b>	<b>Module Level:</b>	1
<b>Module Tutor:</b>	Roger Clowes/Cristina Popescu	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	None	<b>Semester:</b>	Year (DL) Sem 2 (Campus)
<b>Co-requisites:</b>	None		

### ***Module Aims:***

This module presents a broad introduction to the subject of cosmology including theoretical aspects as well as essay writing skills. No prior knowledge of cosmology is necessary and students may undertake this module with a limited background in physics and mathematics. The module provides an informed view of concepts in cosmology which are discussed in terms of the underlying physics. Therefore students are normally expected to have GCSE mathematics or equivalent and experience of GCSE physics is advantageous. It is suitable for distance learning students who have a strong desire to learn about the subject at first year university level, including teachers, members of astronomical societies and those seeking study for their own personal development, or for on-campus students, as part of their degree-level studies.

The module will provide students with:

1. educational material to allow them to logically assimilate information about ideas and concepts in modern cosmology.
2. the background to current developments in the subject area and an awareness of why it is important to continue with future research.
3. an awareness of how cosmology (through astronomical observations) can be used to probe and test the extremes and uncertainties of physics.
4. information that will stimulate further their interest in cosmology and astrophysics.

### ***Syllabus and Content:***

#### **THE BIG BANG - THE SECOND ERA**

- the hot big bang model - the "standard model"
- expansion --> cooling
- hot particles and radiation
- what happened to antimatter
- protons and neutrons form
- atomic nuclei form
- atoms form - recombination
- decoupling - cosmic background radiation

#### **BEFORE THE BIG BANG - THE FIRST ERA**

- inflation
  - theory + speculation
  - why the big bang was hot
  - why the universe expands
  - total energy = zero ?
  - solving the horizon and flatness problems
- cosmology <--> particle physics

**AFTER THE BIG BANG - THE THIRD ERA**

- steady expansion, astrophysics
- the meaning of expansion
- distance becomes harder to define
- Einstein's equations
- redshift
- horizons
- the Cosmic Background Radiation (CBR)
- observational evidence for expansion
  - Hubble
  - Tolman test (1991)
  - CBR hotter in the past
  - absorption lines
- Hubble's constant
- galaxy formation
  - epoch of formation
  - dark matter
  - Hubble Space Telescope images, Keck results.
- open or closed
- exciting research topics

**Teaching and Learning Strategy:**

This module may be studied by distance learning or as an on-campus lecture courses.

- **Distance Learning students** will learn via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule. Each student will receive distance-learning materials including: *Cosmology Course Notes* and *Cosmology Workbook*. The *Course Notes*, which include self-test exercises and are closely linked to a course textbook, are based around how we use observations coupled to basic physical principles to understand the phenomena of the Universe. The *Workbook* contains the assessed coursework and tutorial guidance in scientific writing. Materials are provided on CD-ROM and a Personal Computer is required. Access to the Internet would also be an advantage. Tutorial support will be provided by e-mail, on-line discussion groups (e.g. via the website and WebCT) and telephone.
- **On-campus students** will learn mainly in the classroom through lectures, teaching sessions and tutor led discussions. Some private study will also be necessary to supplement the classroom sessions. Subject material will be provided as a mixture of formal lectures and material used for the DL delivery. These students will have regular tutorials in the classroom and will also be able to participate in the on-line discussion forums.

**Learning outcomes:**

On successful completion of this module, students will be able to:

1. describe or define concepts and cosmological terms from the syllabus and so demonstrate a broad awareness of simple concepts in cosmology
2. solve elementary problems in basic cosmology
3. summarise scientific information and concepts and draw conclusions.
4. use library or on-line resources to research a scientific topic

5. collate material from a variety of sources and write a coherent essay in this subject area

### **Assessment Strategy:**

Assessment will be by coursework only and there is no examination. There are three equally weighted items of coursework normally consisting of

- two question sheets covering the syllabus. Each is a balance of descriptive questions and simple problems
- one essay of about 800 - 1000 words

<i>Component</i>	<i>Typical Weighting</i>	<i>Assessed learning outcomes</i>
(1,3) Question sheets	2×33.3%	1,2,3
(2) Essay	33.3%	3,4,5

It is not necessary to pass each item of coursework individually provided that the essay is attempted and the overall module mark is 40% or more.

### **Bibliography and Learning Support Material:**

*Cosmology Workbook* and *Cosmology Course Notes* for Distance Learning, CD Rom.  
WebCT server: elearn.uclan.ac.uk

Distance Learning Website: <http://www.studyastronomy.com>

### **Recommended textbook:**

Harrison, E. (2000) *Cosmology*, 2<sup>nd</sup> ed, Cambridge University Press..

or (subject to availability)

Hawley J.F. and K. A. Holcomb K.A. 2<sup>nd</sup> Edition, (2005) [Foundations of Modern Cosmology OUP, ISBN-13: 978-0-19-853096-1 ISBN-10 019853096X](#)

### **Suggested further reading:**

<b>Module Title:</b>	<b>IT for Astronomy</b>		
<b>Module Code:</b>	<b>AA1055</b>	<b>Module Level:</b>	1
<b>Module Tutor:</b>	Greg Stinson Francesco Calura	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	AA1051 or AA1053	<b>Semester:</b>	Year (DL)
<b>Co-requisites:</b>	None		

### **Module Aims:**

The module concentrates on PC software and electronic communications appropriate for supporting a study of the subject astronomy. The module assumes minimum previous knowledge of IT. Students *must* have access to office applications and access to the internet (e.g. via an internet service provider, ISP).

- To provide an introduction to the use of PCs in the study of astronomy.
- To introduce the use of world wide web as a source of astronomical information.
- To provide an introduction to the IT skills required for scientific report writing.
- To build the confidence to develop new skills and techniques via on-line tools and to use PCs independently.

### **Syllabus and Content:**

#### **Introduction:**

PC specifications and peripheral components. Operating Systems. Applications software.

#### **Electronic Communications**

The internet, E-mail, e-mail groups, discussion forums and chat tools.

The World Wide Web (WWW) and service providers. Browsing the web. Search engines and data sources, in particular observatory websites, and astronomy project sites (e.g. NASA and ESA space projects).

Introduction to html and web page composition including header tags.

Web publishing. Downloading files and data using http and ftp.

#### **Office Applications**

Use of office suites to prepare documents. Scientific word processing, presentation packages including outlining facilities, and use of spreadsheets. Objects. Using spreadsheets to process astronomical data (e.g. automated distance modulus calculations)

Graphics and database applications.

#### **Astronomical Applications**

The use of a number of astronomical teaching applications, e.g. CLEA, Redshift, Sky Globe, Starry Night etc.

Internet and Java examples.

Image processing tools, FITS file format. PC specific file formats.

**Teaching and Learning Strategy:**

Students will learn via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule. Each student will receive introductory materials to enable them to access the *Course Notes* and *Assessments* electronically (eg using WebCT) including practice exercises based on topics familiar from the pre-requisite modules. Additional material will be available via the Course Website. Students will be encouraged to make frequent contributions to open discussions via electronic forums. A Personal Computer and access to the Internet is essential for this course.

Tutorial support will be provided by e-mail, electronic discussion groups and telephone.

**Learning outcomes:**

On successful completion of this module, students will be able to:

1. use the PC, operating system and office applications effectively
2. use appropriate word processing, spreadsheet and presentation packages and construct simple web pages
3. explore the WWW for astronomical data sources, information and appropriate applications
4. prepare scientific documents that include: simple data analysis, equations, tables, diagrams and images
5. design and build a presentation using outlining features in an office presentation package (e.g. PowerPoint).

**Assessment Strategy:**

Assessment will be by course work only and there is no examination. Some areas of the assessment require students to demonstrate that they have undertaken independent study.

There are three equally weighted items of coursework normally consisting of:-

- ◆ An electronically prepared account of the acquisition of astronomical software from the web, its installation, use and application. (e.g. CLEA packages).
- ◆ Preparation of a word-processed scientific document requiring a spreadsheet to process astronomical data (e.g. similar to HR diagram on Cert in Astronomy)
- ◆ The preparation of a seminar topic using a presentation package

<i>Component</i>	<i>Typical Weighting</i>	<i>Assessed learning outcomes</i>
(1) electronic account of software installation	40%	1,2,3
(2) Scientific document preparation	20%	1,2,4
(3) electronic presentation of seminar	40%	2,3,5

It is not necessary to pass each item of coursework individually provided that all three have been attempted and the overall module mark is 40% or more.

**Bibliography and Learning Support Material:**

Distance learning notes and assessments will be provided on-line.

Distance Learning Website: <http://www.studyastronomy.com>

Support material is available on CD Rom and the WebCT server: [elearn.uclan.ac.uk](http://elearn.uclan.ac.uk)

The On-line learning materials provide links to relevant astronomical websites for information, data and applications.

Office applications' on-line help.

**Suggested further reading:**

R.A.Freedman, W.J. Kaufmann III and R. Geller (2010) *Universe* 9<sup>th</sup> edition, W H Freeman, (paperback).

Krug, S. (2000), *Don't make me think! : A Common Sense Approach to Web Usability* Macmillan: Indianapolis.

Shelley, J. (2000), *How to create pages for the Web using HTML*, Bernard Babani: London.

<b>Module Title:</b>	<b>Energy, Matter and the Universe</b>		
<b>Module Code:</b>	<b>AA1056</b>	<b>Module Level:</b>	1
<b>Module Tutor:</b>	Silvia Dalla Barbara Hassall	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	AA1051, GCSE maths	<b>Semester:</b>	Year (DL)
<b>Co-requisites:</b>	None		

### ***Module Aims:***

The aims of this module are:

- to provide astronomy students with a quantitative understanding of the physical and mathematical concepts underlying astrophysical processes and a foundation for Level 2 study in astronomy.
- to provide an understanding of physical laws and concepts as applied to the Universe.
- to provide the opportunity to develop skills and techniques used in astronomy, which have wider applications (eg problem solving).
- to enable students to solve elementary problems in physics and maths and to use independent judgement and extrapolation /synthesis of concepts to solve more open-ended problems in astronomy

### ***Syllabus and Content:***

#### **Fundamental Interactions**

Gravity according to Newton and Einstein  
Electromagnetism  
Weak and strong nuclear forces

#### **Classical forces and fields**

The physical and mathematical description of gravity and magnetism  
Forces that push and pull: Newton's laws, linear momentum  
Forces that turn: torque and angular momentum

#### **Motion of objects**

Describing motion  
Orbits: planetary, stellar and spacecraft  
Rotating bodies: planets, stars and galaxies  
Particle trajectories

#### **Energy**

Energy of motion: the kinetic energy of particles and bodies; rotational KE  
Energy of place: gravitational potential energy  
Forces: doing work and transferring energy  
Energy stored in fields: electromagnetic field energy density

#### **Light in the Universe**

Emission and absorption of light: classical and quantum processes  
The spectrum of light  
The nature of light: electromagnetic waves and photons

#### **Matter in the Universe**

The fundamental particles: the particle zoo; particle transformations and decays  
The core of atoms - nuclei: atomic number and weight; isotopes  
Changing nuclei: binding energies; fission; fusion; particle capture and emission

Creating the elements

The rest of the atom - electrons and shells: Bohr model and simple quantum physics

### **Light and Matter: Fundamentals of Spectroscopy**

Characteristic spectra of the elements

Formation of spectra: electronic structure; emission and absorption of photons

The atom alone: the effects of temperature on electron states and spectra

The atom in a gas: the effects of pressure on spectral lines

### **Heat and Matter**

The meaning of temperature

The meaning of 'heat' energy

Thermal properties of gases: the ideal gas law; other equations of state

Energy stored: heat capacity in gases; degrees of freedom

### **Relativity**

The absolute velocity of light

The effects of relative motion: time dilation and length contraction; the mysterious muon

Einstein's gravity: the warping of space and time; black holes

### **Mathematics**

Understanding functions in physics: physical variables and parameters

Manipulating and displaying variables: simple functions and plots

Properties and use of trigonometric functions

Interpreting and solving algebraic equations in physics

Describing motion: co-ordinates and vectors

Physical meaning of differentiation and integration

Differentiating and integrating useful functions in physics

The meaning of simple differential equations in physics: Newton's laws, equations of state

### **Teaching and Learning Strategy:**

Students will learn by applying physical concepts to astronomical processes via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule. Each student will receive *Course Notes* and a *Workbook* containing both the assessed coursework and a series of self-test exercises for the student to complete and compare to model answers provided. Each topic will be accompanied by an introduction to the mathematical tools required.

Tutorial support will be provided by e-mail, electronic discussion groups and telephone. Materials are provided on CD-ROM and a Personal Computer is required. Access to the Internet would also be an advantage.

The distance learning website provides additional learning materials and guidance in using the supplied materials and in applying the material in a wider context.

### **Learning Outcomes:**

On successful completion of this module, students will be able to:

1. explain physical concepts relevant to a range of astronomical topics.
2. use relevant physical and mathematical concepts and tools to solve simple problems in physics and astronomy.

3. use independent judgement and extrapolation /synthesis of concepts to solve open-ended problems in astronomy

### **Assessment Strategy:**

Assessment is by coursework only and there is no examination. There are four equally weighted items of coursework normally consisting of

- *three* question sheets covering simple problems and well-defined applications of physical concepts
- final *open-ended problem*

<i>Component</i>	<i>Typical Weighting</i>	<i>Assessed learning outcomes</i>
(1,2,3) Question sheets	3×25%	1,2
(4) Open-ended problem	25%	3

It is not necessary to pass each item of coursework individually provided that the open-ended problem has been attempted and the overall module mark is 40% or more.

### **Bibliography and Learning Support Material:**

*Energy, Matter and the Universe Workbook* and *Course Notes* for Distance Learning, CD Rom.

WebCT server: [elearn.uclan.ac.uk](http://elearn.uclan.ac.uk)

Distance Learning Website: <http://www.studyastronomy.com>

### **Recommended textbook:**

Tipler, P.A. and Mosca, G., *Physics for Scientists and Engineers, Extended Version*, 6th edition, 2008, W.H.Freeman & Co Ltd; (Be sure to get the Extended Version with 41 chapters plus appendices.)

### **Suggested further reading:**

Stroud, K.A and Booth, D. (2007), *Engineering Mathematics* 6th Ed. Palgrave Publishers Ltd.

Zeilik, M and Gregory, S.A. (1998), *Introductory Astronomy and Astrophysics*, 4<sup>th</sup> Ed. Saunders College Publishing.

<b>Module Title:</b>	<b>Investigations in Astronomy</b>		
<b>Module Code:</b>	<b>AA1057</b>	<b>Module Level:</b>	1
<b>Module Tutor:</b>	Stewart Eyres/ Ian Butchart	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	AA1051 and AA1053 or equivalent	<b>Semester:</b>	Year (DL)
<b>Co-requisites:</b>	AA1055 or equivalent		

### **Module Aims:**

This module is designed to enable students to demonstrate that they have the ability to integrate subject knowledge and skills across individual modules composing the *Certificate of Higher Education in Astronomy*.

The module draws together scientific themes and concepts found in the core modules *Introduction to Astronomy* and *Introduction to Cosmology*, providing students with the opportunity to conduct in-depth study through research of appropriate topics. The students are expected to make significant use of the IT skills developed in AA1055.

### **Syllabus and Content:**

The subject matter for this module is the same as the subject material in AA1051 *Introduction to Astronomy* and AA1053 *Introduction to Cosmology*.

Students will select topics for a more detailed investigation. Possible topics might be:

- The Astronomical Distance Ladder.
- Exploration of the Cosmic Microwave Background, past, present and future.
- The Development of Large Ground-Based Telescopes.
- Active Galaxies
- Galactic Structure
- Space Technology

### **Teaching and Learning Strategy:**

This module makes further use of the Course Notes for each of the core modules AA1051 and AA1053. Supplementary material on specific topics will be provided on the website. A Personal Computer and access to the Internet are essential for this course.

A *Workbook* will provide guidance on relevant research methods, and techniques of summarising selected topics.

The first topic (e.g. *The Astronomical Distance Ladder*) will be specified in the *Workbook* together with details of the appropriate research methods and structure for the written presentation of the subject matter. Students will be asked to submit an extensive summary of the main issues and problems. Detailed feedback will be provided on this initial report before the students submit the second item of coursework.

The students will have a choice for their second and third topics and will be expected to show increasing independence in producing the report, and in their presentation skills. For the third item of coursework, students will be required to create an on-line presentation (e.g. using PowerPoint), in addition to the written report.

### **Learning Outcomes:**

On successful completion of this module, students will be able to:

1. use library or on-line resources independently to research an astronomical topic
2. present a coherent summary of information relating to a single topic
3. extract key issues and arguments from a number of sources to synthesise different strands of subject material
4. write a coherent and structured scientific report using appropriate IT packages
5. prepare a competent on-line presentation of an astronomical topic.

### **Assessment Strategy:**

Assessment will be by coursework only and there is no examination. There are three items of coursework all of which must be prepared electronically.

Students will be expected to write a report on each of three different topics:

1. initial report of 1000 words - to provide feedback on the student's progress
2. report of 1600 words
3. report of 2500 and an on-line presentation designed to last no more than 10 minutes.

<i>Component</i>	<i>Typical Weighting</i>	<i>Assessed learning outcomes</i>
First Topic - Initial Report	25%	2,3,4
Second Topic - Report	30%	1,3,4
Third Topic - Report	35%	1,3,4
- On-line Presentation	10%	5

It is not necessary to pass each item of coursework individually provided that all times have been attempted and the overall module mark is 40% or more.

### **Bibliography and Learning Support Material:**

Students will have previously studied AA1051 and AA1053 and therefore will have access to the relevant learning materials. Please see bibliographies of the above modules.

*Investigations Workbook* and *Course Notes* for Distance Learning, CDRom.

WebCT server: [elearn.uclan.ac.uk](http://elearn.uclan.ac.uk)

Distance Learning Website: <http://www.studyastronomy.com>

Students will have access to library facilities through the DLS and are recommended to have internet access (e.g. via a service provider).

<b>Module Title:</b>	<b>Sun, Earth and Climate</b>		
<b>Module Code:</b>	<b>AA1058</b>	<b>Module Level:</b>	1
<b>Module Tutor:</b>	Silvia Dalla /Robert Walsh	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	None	<b>Semester:</b>	Year (DL)
<b>Co-requisites:</b>	None		

### **Module Aims**

The aims of this module are:

- to provide an understanding of physical laws and concepts as applied to the Sun-Earth system and the Earth's climate.
- to provide an introduction to aspects of observational solar astronomy, including the ways in which our Sun (a variable star) can affect the Earth's environment in space and how it may influence our climate.
- to provide elementary problem solving skills.
- to provide the opportunity to develop skills and techniques used in solar astronomy and solar-terrestrial physics, which have wider applications (these include data analysis, preparation of scientific reports).
- to enhance the student's key skills.

### **Syllabus and Content**

This course covers a number of topics:

#### **The Solar System**

The Sun and Earth are presented in the context of Astronomy, with a description of orbital motions, Kepler's Laws, Newtonian gravitation, solar eclipses, transits of Mercury and Venus and related phenomena. Basics Physics concepts of relevance to the course are also introduced: these include charged particles; electrical, gravitational and magnetic forces and fields; the concept of astrophysical plasmas; and the nature of light and the electromagnetic spectrum.

#### **The structure of the Sun and the Earth**

Brief overview of internal structure of Sun and Earth, leading to characteristics of the various regions of the solar and terrestrial atmospheres; comparison between the magnetic field of the Sun and the Earth; names and dimensions of the atmospheric layers; the structure of the magnetosphere and ionosphere. The solar spectrum as seen from the Earth. The sunspot cycle and the solar dynamo; Maunder minimum; "proxies" for solar activity.

#### **Observations of the Sun and the Earth**

Techniques for safe solar observing (also refer to workbook exercise on safe observing); solar and Earth observations from the ground and from space; historical observations; solar features; geomagnetic observations and indices; weather stations.

#### **Energy from the Sun to the Earth**

The flow of energy from Sun to Earth is described in its various forms. The concepts of solar irradiance and insolation are introduced, and the way in which they affect the Earth's energy budget discussed. The influence on the Earth of solar flares and Coronal Mass Ejections.

**Earth's climate and climate change**

Brief review of selected components of the Earth's climate: general circulation; cyclones/anticyclones; quasi-biennial oscillation; El Niño/La Niña. Observational evidence of global warming is reviewed and the role of climatic forcings discussed, including anthropogenic forcing from greenhouse gas emissions and solar forcing.

**Space Weather**

The effects of solar eruptions on the Earth's space environment and technologies are presented. The phenomenon of the Aurorae and its link to solar events are discussed.

**Sun, Earth and Climate Workbook.**

Introduction to safe solar observing: projection techniques, telescopes. Data analysis exercises, question sheets and assessment briefing.

**Teaching and Learning Strategy:**

This level 1 module is available by distance learning as a University Certificate, or as a module within the Cert HE in Astronomy. It is at first year undergraduate level, is equivalent to 20 national credits and requires about 200 hours of study.

Course Notes are supplied on CDRom or can be downloaded from the Web, and are complemented by a recommended course textbook. Tutorial support is provided via the Web, email and telephone.

The student is encouraged to develop questions from the solar and solar-terrestrial observations presented in the introductory section. These questions will then be addressed throughout the module. The enquiring process will be further facilitated by the use of a discussion thread set up on the module WebCT site, where effective interactions between students and tutor will be encouraged. However, the assessment process will not depend on access to the web.

The module will involve a mixture of theoretical and observational approaches. The workbook will include some question sheets as well as data-based and observational exercises but you do not need a telescope or other specialist astronomical equipment to complete this course.

The observational exercises combine data analysis and simple, safe observations that can be carried out at home without any specialist equipment. The assessed work requires analysis of solar and geophysical data which is supplied on the CDRom, but may be supplemented by data from the web.

It is indispensable for students to have access to a PC, and it is highly recommended that they have internet access to gain greatest advantage from this course.

**Learning Outcomes**

On successful completion of this module, students will be able to:

1. describe or define concepts and astronomical terms from the syllabus and so demonstrate a knowledge of basic concepts in solar astronomy and solar-terrestrial physics (stp)
2. solve elementary problems in basic solar astronomy and stp
3. demonstrate elementary skills in *safe* solar observation, measurement, and log keeping

4. demonstrate elementary data analysis and laboratory report writing skills
5. summarise simple scientific information and concepts and draw conclusions. (eg following a laboratory experiment or observation)

### **Assessment Strategy:**

Assessment will be by coursework only and there is no examination. There are four equally weighted items of coursework normally consisting of:

1. two question sheets covering the syllabus. Each is a balance of descriptive questions and simple problems
2. two activities involving practical/data analysis techniques and scientific report writing.

Components	Typical weighting	Assessed Learning Outcomes
(1,2) Question sheets	2 × 25%	1,2
(3,4) Experimental Reports	2 × 25%	3,4,5

It is not necessary to pass each item of coursework individually provided that at least one question sheet and one Workbook Activity has been attempted and the overall module mark is 40% or more.

### **Bibliography and Learning Support Material**

Sun, Earth and Climate Course Notes for Distance Learning and CDRom.

Sun, Earth and Climate Workbook.

WebCT server: Elearn.uclan.ac.uk and

Web Site (<http://www.studyAstronomy.com>).

#### **Recommended textbook:**

No single book covers all this module at the correct level. Those of you in possession of *Universe* 8<sup>th</sup> edition will find the chapters on the Sun and Earth useful:

R.A.Freedman and W.J. Kaufmann III (2007) *Universe* 8th edition with CD ROM. W H Freeman.

#### **Suggested further reading:**

Golub, L and Pasachoff, J.M., (2002), *Nearest Star: The Surprising Science of Our Sun*, Harvard University Press.

Wolfson, R, (2008), *Energy, Environment and Climate*, Norton.

Ruddiman W.F., (2007), *Earth's Climate: Past and Future*, 2<sup>nd</sup> Edition, Freeman.

Hanslmeier, A, (2002), *The Sun and Space Weather*, Kluwer Academic Publishers.

## MODULE DESCRIPTOR

<b>MODULE TITLE</b>	<b>Introduction to Astrobiology</b>		
<b>MODULE CODE</b>	<b>AA1059</b>	<b>CREDIT VALUE</b>	<i>20 credits</i>
<b>MODULE DELIVERY</b>	<i>year long</i>		
<b>MODULE TUTOR</b>	<i>Ian Butchart with Stewart Eyres</i>		
<b>DATE APPROVED</b>	<i>2 May 2007</i>	<b>VERSION NUMBER</b>	1
<b>DEPARTMENT</b>	<b>Physics, Astronomy and Mathematics</b>	<b>PARTNER INSTITUTION</b>	<b>None</b>

### RELATIONSHIP WITH OTHER MODULES

<b>Co-requisites</b>	<b>None</b>	<b>Pre-requisites</b>	<b>None</b>	<b>Excluded Combinations</b>	<b>None</b>
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### MODULE AIMS

This module presents an introduction to astrobiology including the basic knowledge of chemistry and astronomy appropriate for the understanding of the biochemistry underpinning life in the universe. There will be a discussion of the definitions of life as we currently understand it.

The module also discusses appropriate chemistry and biology that enables us to formulate our understanding of how life started and evolved in the universe. Astronomical sites that can support the basic processes will be discussed. The module will finally discuss some of the Human Factors to be considered if we are to explore the local neighbourhood of the universe.

No prior knowledge of biology, chemistry or astronomy is necessary. However students are normally expected to have at least one GCSE in a science subject. Enthusiasm and commitment from those with a life-long interest in science will be important. The student will be able to develop appropriate skills and techniques, which will have a wider application in scientific work. Many of these skills will also have broad applicability beyond science.

### MODULE CONTENT

**Life on Earth:** life sustaining environments, evolution, origins, range, limitations. Chemistry/biochemistry. Fossil records.

**Solar System Sites that might support life:** Mars, Titan, Europa. Also Enceladus, Io and Jupiter. Sites with the possibility of liquid water, complex chemistry and organic

material. Comets.

**Search for terrestrial planets:** detection techniques, searching for planetary atmospheres and chemical composition. Space missions and ground-based surveys. Signatures of appropriate biochemistry.

**Extraterrestrial biochemistry:** Alternatives to carbon and oxygen, other probable processes, constraints of physics, biology and chemistry on possibilities

**Space origins of life:** panspermia, comets as a source of biological material, life on Mars

**Human factors for space exploration:** physiological and psychological impact of isolation, crowded or constrained living and working spaces and engaging in high risk activities

**Environmental influences on life:** radiation, gravity, temperature, pressure, atmospheric composition, extremophiles as examples of life in unexpected places

## LEARNING OUTCOMES

**On successful completion of this module a student will be able to:**

1.	Describe biochemical and physical processes that take place in the universe with relevance to astrobiology
2.	Describe a range of environments capable of supporting a wide range of life forms
3.	Conduct a scientific investigation and rigorously report on the outcomes
4.	Solve elementary problems and apply appropriate practical skills

## TEACHING AND LEARNING STRATEGY

Off-campus distant learning students will learn via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule.

Each student will receive Course Notes with worked examples and a Module Workbook containing the assessed coursework and self-test exercises. Additional material will be available, via the Course Website and the recommended course textbook, to supplement the examples given in the Workbook. Some of the assignments contain questions to encourage students to solve conceptual and numerical problems.

The subject content will be provided in the form a distance learning notes together with self-test problems.

A handbook of activities that build on the main subject content will be provided, including assessed activities. These could be observations, experiments or data analysis and will lead to formal scientific reports. Assignments in the form of question sheets to test subject knowledge and understanding.

Tutorial support via telephone, e-mail, web discussions (in Web CT) as required and in direct support of preparation for submitting assessed work.

### INDICATIVE CLASS CONTACT

This module is intended to be delivered as a Distance Learning module with on-line tutorials and requires approximately 200 hours of study time normally evenly spread throughout the 2 semesters

The total subject knowledge is presented as a series of 12 to 14 chapters (flexibility is introduced because this is a new area and it may be necessary to repackage the material as up-to-date material becomes available). Ideally a student will read and study one chapter every 2 weeks over two semesters. There will be on-line tutorials (1 hour) to support this material held once per month – timed before the assessments are due.

### INDICATIVE ASSESSMENT

*The assessment strategy for this module is designed to test all the learning outcomes. Students must demonstrate successful achievement of these learning outcomes to pass the module.*

Number of Assignments	Assessment	Weighting %	Type/Duration/ Wordcount (indicative only)	Learning Outcomes being assessed
2	<i>Question/Problem sheets</i>	2 x 25%	<i>Problems and short descriptions</i>	1,2 4
2	<i>Activity</i>	20% + 30%	<i>Formal Scientific Report</i>	3, 4

### MODULE PASS REQUIREMENTS

To pass the module students must attempt at least one problem sheet and one activity (to satisfy all the learning outcomes) and obtain an average mark of at least 40%.

### BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL

*AA1059 Introduction to Astrobiology*, Course Notes, uclan

Gilmour, Iain and Sephton, Mark A, 2004 *An Introduction to Astrobiology*, Open University .

Plaxco, Kevin W. and Gross, Michael, 2006 *Astrobiology: A Brief Introduction*, The Johns Hopkins University Press.

Lunine, Jonathan Irving, 2005, *Astrobiology : a multidisciplinary approach*, Pearson/Addison Wesley.

<b>Module Title:</b>	<b>Great Astronomers in History</b>		
<b>Module Code:</b>	<b>AA1066</b>	<b>Module Level:</b>	1
<b>Module Tutor:</b>	Paul Marston/ Gordon Bromage	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	None	<b>Semester:</b>	Year (DL)
<b>Co-requisites:</b>	None		

### **Module Aims:**

This module presents an analysis of key astronomers and their discoveries in the period from ancient Greece until 1900. Through this, it aims to promote understanding both of the nature of historical study, and the nature and dynamics of scientific discovery in its cultural context. To better achieve its aims the module will focus on some key individuals and issues in astronomy. Its aim is insight rather than comprehensiveness.

The module is aimed at those with a general interest in astronomy, to encourage them to take a broader perspective on their interest, and at those with an interest in history to encourage them to expand into the history of science. No previous knowledge of the subject is assumed, but students are normally expected to have GCSE English or equivalent.

### **Syllabus and Content:**

#### **1. The nature of history and science**

History as a human account of what happened, which therefore involves perspective. Selection and perspective and the limits of historical subjectivity. Science also involving 'ways of seeing' not simple accretion of fact. The fascination of the history of science: combining cultural influence and interaction with observational results.

#### **2. The Greek beginnings.**

The presocratic foundational elements: Ionian naturalism, Pythagoreanism, and rationalism as enduring approaches within science. Platonism: mathematics, permanence, ideal forms and the unreliability of observation. Tradition of 'saving the phenomena'. Aristotelianism: common sense, observation and mechanics as an approach to science. The implausibility of the heliocentric system of Aristarchus. The Almagest and the legacy of Ptolemy.

#### **3. Nicholas Copernicus**

Cultural background of Copernicus and what he would have studied. The character and motivation of Copernicus, and the stages in revealing his theory. The actual system of Copernicus – what was on offer? The influence of Copernicus.

#### **4. Tycho Brahe**

The life of a Great Dane. Tycho's system and empiricism – the missing parallax. The legacy of observation.

#### **5. Johannes Kepler**

Kepler: genius, mystic, Lutheran and myopic astronomer. The regular solids: refocus from position to shape of orbit. 'Sleepwalking' to an elliptical orbit. The three laws – embedded in mysticism. The new physics of a sun driven system. The invention of gravity and science fiction. Kepler: unique genius.

#### **6. Galileo Galilei**

Background of 'the wrangler'. Being most famous for what you never did. Galileo and the Jesuits: sunspots and monkey planets. Letter to the Grand Duchess and

Bellarmino's response. The Dialogue on the Two Systems: structure, argument, invalidity and datedness. Trial and judgement: myth and reality. Galileo's real legacy.

### **7. Jeremiah Horrocks**

Background of Cambridge. Telescope observation and the transit of Venus. Extension of Kepler's laws, and the scale of the solar system.

### **8. Isaac Newton**

Background: Horrocks, Halley, Flamsteed, and Descartes. Newton's life and interest: first modern scientist or last magician? Mathematical keys to all knowledge. Elements of Newtonian theory: rules of reasoning + inverse-law gravity + inertia, + calculus = Kepler's laws? Newton and Descartes. Newton and Hooke. Newton and Leibniz. Reflecting telescopes. The legacy of Newtonianism. Laplace and the completion of the process.

### **9. William Herschel: Galaxies and stellar dynamics**

Musician and instrument-maker extraordinaire. The telescope and the observatory. Concepts of the galaxy and stellar evolution. Theory, assumption and observation in Herschel's thought. Inhabitable sun. John's Herschel and Earl of Rosse continue the tradition.

### **10. Theoretical and Observational Astronomy**

The discovery of Neptune and Uranus, the observers and the theoretical work of Adams and Leverrier. Theory guiding observation.

### **11. Physics and Astronomy: the interconnection of science.**

Kirchoff and the new role of spectrum analysis. Kelvin, assumptions, the earth's age and the sun's history. The controversy with Darwinists.

### **12. Extra Terrestrials and the Emperor's New Canals?**

Plurality and the Whewell-Brewster debate. Lowell and his early work. The canals of Mars: mistaken paradigm or delusion?

## ***Teaching and Learning Strategy:***

Students will learn via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule. Each student will receive *Course Notes* and a *Workbook* containing the assessed coursework, comprehensive bibliography and guidance in preparing essays and book reviews. To complete essays students will need to be able to critically compare and assess materials from diverse sources, including relevant reprints of original sources (in translation if appropriate).

Supplementary materials will be available on the course website.

Tutorial support will be provided by e-mail, on-line discussion groups and telephone.

## ***Learning Outcomes:***

On successful completion of this module, students will be able to:

1. explain the nature of historical study as applied to science, recognising the need to avoid 'hindsight' with concepts not available to contemporaries
2. write a coherent, researched essay on the subject matter
3. recognise and explain the paradigmatic nature of science, and the dynamics of the development of scientific ideas

4. describe and illustrate the context in which key astronomers operated and developments in astronomy in the period up to 1900.

### **Assessment Strategy:**

Assessment will be by coursework only and there is no examination. There are two shorter equally weighted items of coursework and an essay.

Examples of the assessment are:

1. A book review (of 1000-1500 words)
2. Role Play Letter (of 1000-1500 words)
3. Essay (of 3000-3500 words)

<i>Component</i>	<i>Typical Weighting</i>	<i>Assessed learning outcomes</i>
(1) Book review	25%	1,4
(2) Role play letter	25%	1,4
(3) Essay	50%	2,3,4

It is not necessary to pass each item of coursework individually provided that the essay has been attempted and the overall module mark is 40% or more.

### **Bibliography and Learning Support Materials:**

*History of Astronomy Workbook* and *Course Notes* for Distance Learning, CDRom.

WebCT server: [elearn.uclan.ac.uk](http://elearn.uclan.ac.uk)

Distance Learning Website: <http://www.studyastronomy.com>

#### **Recommended textbook:**

In addition to the Course Notes provided, the recommended text for an overview of astronomical history is:

Hoskin, M. (1999), *Cambridge Concise History of Astronomy*, CUP, paperback or  
or

Hoskin, M. (1997), *Cambridge Illustrated History of Astronomy*, Cambridge  
University Press. (Out of print – 2<sup>nd</sup> hand copies often available).

#### **Suggested further reading:**

To get a feel of the earlier figures, the following text is readable and fairly accurate:

Koestler, A. (1984) *The Sleepwalkers*, Penguin, or Arkana (1989).

To write an essay, however, is it inappropriate to rely only on a core text, and the module workbook will contain a supplementary list from which students may select additional reading for their essay.

<b>Module Title:</b>	<b>The Milky Way</b>		
<b>Module Code:</b>	<b>AA2051</b>	<b>Module Level:</b>	2
<b>Module Tutor:</b>	Gordon Bromage/ Stewart Eyres/	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	AA1051	<b>Semester:</b>	Year (DL) Sem 1 (Campus)
<b>Co-requisites:</b>	None		

### **Module Aims:**

This module provides a broad introduction to the content, structure and evolution of the Milky Way. It demonstrates how we use observations coupled to basic physical principles to arrive at our current understanding of the Galaxy. Its approach is quantitative without taking a highly mathematical approach. It also provides practice in subject specific skills such as discussing and reviewing astronomical concepts and scientific essay writing.

### **Syllabus and Content:**

#### **1. The Milky Way: past, present and future.**

Context of evolution in the universe. Revising and reviewing relevant parts of the AA1051 Introduction to Astronomy (level 1) course including Section 11 (galaxies) and parts of stellar lifecycle.

#### **2. The solar neighbourhood.**

Distances, star number densities, types of stars and structures; the Sun in an old SNR cavity; SNR gas; local disk structure; local motions and local moving group (giving age).

#### **3. Nebulae and Giant Molecular Clouds: stellar nurseries in the Galaxy.**

Gaseous nebulae; cold interstellar gas - optical discovery, stationary lines in SB2s, atoms and molecules; star formation sites, Orion, hot interstellar gas, plasma, the X-ray Galaxy.

#### **4. Star clusters: open and globular.**

Pleiades with gas (reflection nebula). Other young/younger open clusters. Types of stars in open clusters. Hyades. Globular clusters; their positions and dynamics in the Galaxy. Population I and II (and III) stars in clusters etc.

#### **5. Interstellar dust.**

Discovery of interstellar obscuration from open clusters observations. Absorption, scattering, wavelength-dependence. Reddening, colour excess and distance modulus. What the dust grains are made of. Composition, shape (via magnetic fields and polarisation), sizes. Radio, IR, X-rays less affected. Role of gas and dust in the life of the Galaxy.

#### **6. The Radio Galaxy: spiral arms.**

21cm and other radio lines explained as tools to probe the overall structure of the galactic disk. Spiral structure compared with Keplerian orbits of individual stars etc. Spiral density waves (Pop I and how the spiral arms are 'lit up'). Radio observation of molecules, ethyl alcohol, cyanide, complex organic molecules and life in the Galaxy.

**7. Dark Matter and the Halo**

Pop II, bulge and halo. Dynamical mass; velocity distribution. Evidence for dark matter in the Galaxy. Searches for it. What's in the halo. MACHOs. Elementary particles, normal and exotic and neutrinos.

**8. Journey to the Centre of the Galaxy**

Towards the Centre. The IR Galaxy and IR sources. Barred spiral? Supermassive black hole? (Recent evidence) The birth and death of the Galaxy.

**Teaching and Learning Strategy:**

- **On-campus students** will learn via lectures and tutorial sessions that will be supported by some of the educational resources available to the off-campus students.
- **Off-campus distant learning** students will learn via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule.

Each student will receive *Course Notes* with worked examples and a *Workbook* containing the assessed coursework and self-test exercises. Additional material will be available, via the Course Website and the recommended course textbook, to supplement the examples given in the *Workbook*. Some of the assignments contain questions to encourage students to solve conceptual and numerical problems. The essay assignment will be prefaced by guidance on researching and writing a scientific essay.

Tutorial support for off-campus students will be provided by e-mail, electronic discussion groups and telephone. Students will be encouraged to participate in on-line or class discussions.

**Learning outcomes:**

On successful completion of this module, students will be able to:

1. describe the contents and discuss the complexities of the overall structure of the Milky Way.
2. explain the physical principles and processes involved in the Galaxy's evolution and relate them to its present-day structure
3. solve numerical problems in this subject area (e.g. relating to the dynamics of the component stars or involving the interplay of a number of physical processes).
4. plan, research and produce a structured scientific essay in this subject area.
5. analyse conceptual problems, make inferences and provide reasoned arguments to justify the conclusions drawn.

**Assessment Strategy:**

Assessment will be by coursework only and there is no examination. There are four items of coursework normally consisting of:

- 3 question sheets with a balance of numerical and conceptual questions and summaries.
- 1 scientific essay 1500-2000 words

<i>Component</i>	<i>Typical Weighting</i>	<i>Assessed learning outcomes</i>
(1,2,3) Question sheets	20%, 25%, 25%	1,2,3
(4) Scientific essay	30%	2,4,5

It is not necessary to pass each item of coursework individually provided that the essay has been attempted and the overall module mark is 40% or more.

***Bibliography and Learning Support Material:***

*The Milky Way Workbook* and *Course Notes* for Distance Learning, CDROM.

WebCT server: [elearn.uclan.ac.uk](http://elearn.uclan.ac.uk)

Distance Learning Website: <http://www.studyastronomy.com>

**Recommended Textbook:**

Sparke, L.S., & Gallagher, J.S., (2007), *Galaxies in the Universe*, 2<sup>nd</sup> edition  
Cambridge University Press, (paperback).

**Suggested further reading:**

Binney, J., & Merrifield, (1998), *Galactic Astronomy*. Princeton University Press.

Details of a selection of relevant web sites will be given in the workbook and posted on-line.

<b>Module Title:</b>	<b>Galaxies Beyond the Milky Way</b>		
<b>Module Code:</b>	<b>AA2052</b>	<b>Module Level:</b>	2
<b>Module Tutor:</b>	Francesco Calura/ Greg Stinson	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	AA1051, AA2051	<b>Semester:</b>	Year (DL)
<b>Co-requisites:</b>	None		

### **Module Aims:**

This module provides a broad introduction to galaxies beyond the Milky Way, based on multi-waveband observations coupled to basic physical principles to understand the phenomena of galaxies in the Universe.

The module will:

- provide students with an understanding of where our Galaxy is and the characteristics of other types of galaxies in the universe.
- enable students to carry out estimates of physical properties of galaxies (e.g. current structure, past history) given observational data.
- give students a broad overview of how our understanding of galaxy evolution is changing; our current ideas and future observations with new instruments in different wavebands which will aim to answer questions about galaxy evolution in the next decade or so.
- provide practice in transferable skills relevant to communicating scientific concepts.

### **Syllabus and Content:**

#### **THE LOCAL UNIVERSE**

- Classification by morphology
- Stellar content
- Theoretical considerations
- Interstellar medium
- Disks, bars and spiral arms

#### **DYNAMICS**

- Motions within galaxies
- Galaxy masses, missing mass in galaxies
- Powering of AGN
- Jets from galactic nuclei
- Velocity-distance relation

#### **THE LOCAL GROUP**

- Morphology and distribution
- Star formation history
- Future evolution

#### **CLUSTERING OF GALAXIES**

- Clusters and superclusters
- Morphological mix
- Cluster dynamics, missing mass in clusters
- Motion of our Galaxy in the universe

#### **EVOLUTION**

- Evolution in the universe from the big bang
- When did galaxies first appear?

- Changes with look-back time
- Galaxy interactions

### **CHALLENGES FOR THE FUTURE**

- The problem of the first stars
- Dwarf galaxies
- Absorption line systems
- Future instrumentation

### **Teaching and Learning Strategy:**

- **On-campus** students will learn via lectures and tutorial sessions that will be supported by some of the educational resources available to the off-campus students.
- **Off-campus** distant learning students will learn via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule.

Each student will receive *Course Notes* with worked examples and a *Workbook* containing the assessed coursework and self-test exercises. Additional material will be available, via the Course Website and the recommended course textbook, to supplement the examples given in the *Workbook*. Some of the assignments will contain questions to encourage students to solve conceptual and numerical problems. Other assignments are aimed at broadening their awareness of different sources of information, with particular emphasis on the use of web resources. The coursework assessments will expand on themes developed in the *Workbook*.

### **Learning outcomes:**

On successful completion of this module, students will be able to:

1. describe the structure and characteristics of different types of galaxies and how this is inferred from multi-wavelength observations.
2. use basic physical and astrophysical principles to explain the phenomena of galaxies in the universe.
3. solve well-defined problems in this subject area requiring some integration of concepts.
4. exploit up-to-date astronomical data source, consolidating information from a variety of specified websites.
5. analyse astronomical data to investigate open-ended problems.
6. summarise scientific information and concepts, evaluate results and draw conclusions.
7. write structured and coherent scientific documents (including appropriate use of structured text, tables, graphs, equations, images *etc*).

### **Assessment Strategy:**

The module assessment is by coursework only. There is no examination. There are three items of coursework assessments. Examples of these are:

- Question sheet with a balance of numerical and conceptual questions and summaries.
- Use of web database resources to carry out multi-waveband analysis of a galaxy and present the results in a report.

- Summary of the main content and results of a scientific article on a relevant topic from a publication such as New Scientist, Scientific American or a review article available on the web.

<i>Component</i>	<i>Typical Weighting</i>	<i>Assessed learning outcomes</i>
(1) Question sheet	30%	1,2,3
(2) Data Analysis report	40%	4,5,6,7
(3) Summary of article	30%	6,7

It is not necessary to pass each item of coursework individually provided that all three have been attempted and the overall module mark is 40% or more.

### ***Bibliography and Learning Support Material:***

*Galaxies Workbook* and *Course Notes* for Distance Learning, CDRom.

WebCT server: [elearn.uclan.ac.uk](http://elearn.uclan.ac.uk)

Distance Learning Website: <http://www.studyastronomy.com>

### **Recommended Textbook:**

Sparke, L.S, & Gallagher, J.S., (2007), *Galaxies in the Universe*, 2<sup>nd</sup> edition Cambridge University Press, (paperback).

### **Further suggested reading:**

Tayler, R.J., (1993), *Galaxies: structure and evolution*, Cambridge University Press.

Binney, J., & Merrifield, (1998), *Galactic Astronomy*. Princeton University Press.

Details of a selection of relevant web sites will be given in the workbook and posted on-line.

**MODULE DESCRIPTOR**

<b>MODULE TITLE</b>	<b>Ultraviolet, Optical and Infrared Astronomy</b>		
<b>MODULE CODE</b>	<b>AA2053</b>	<b>CREDIT VALUE</b>	Single module (20 credits)
<b>MODULE DELIVERY</b>	Year long (Distance Learning)		
<b>MODULE TUTOR</b>	Anne Sansom, Mark Rushton, Barbara Hassall		
<b>DATE APPROVED</b>	<i>Date when module was approved or last changed ?</i>	<b>VERSION NUMBER</b>	1.0
<b>SCHOOL</b>	CEPS	<b>PARTNER INSTITUTION</b>	-

**RELATIONSHIP WITH OTHER MODULES**

<b>Co-requisites</b>	NONE	<b>Pre-requisites</b>	AA1051	<b>Excluded Combinations</b>	-
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**MODULE AIMS**

The aims of this module are:

- to provide students with a detailed understanding of astronomical detectors and technologies for the ultraviolet, optical and infrared wavelengths. Case studies show the relevance of the techniques to small telescopes and professional satellite and ground-based observing.
- to provide an understanding of physical laws and concepts as applied to Astronomy.
- to provide an understanding of the techniques and the opportunity to develop their skills in quantitative observational astronomy (incorporating the use of telescopes, astronomical detectors and data visualisation).
- to provide the opportunity to develop techniques used in astronomy which have wider applications (e.g. data reduction software installation and use, data analysis, imaging techniques, preparation of scientific reports, and IT).
- to enhance the student's key skills in data analysis, astronomical techniques and application of related physical concepts.

**MODULE CONTENT**

Atmospheric Effects

The effects of the atmosphere on observations - extinction, air mass, refraction, dispersion, seeing. Sky background radiation.

Telescopes

Limits to resolution. Limiting magnitude. Characteristics of good observing sites. Telescope mountings and focuses. Optical aberrations. Planning an observing programme.

#### Photometry

Photometric techniques. Magnitudes and photometric systems, astronomical applications.

#### Detectors

Single-pixel and multi-pixel detectors. Photoemissive process. Photoconductive process. Semiconductors. Photography. Micro-channel plates. Junction diodes. p-i-n diodes. CCDs. Infrared arrays. Bolometers. Signal-to-noise ratio.

#### Experimental and observational work

Distance learning students can use their own equipment and/or data provided from the University, plus analysis software from specified open access data reduction software sources. Each student is required to plan and carry out observational experiments involving detectors and/or data reductions. The experimental work will normally consist of a number of familiarisation exercises to develop the student's practical skills before tackling the formally assessed work. The experimental work will be written up as a formal report including evidence that they have planned the main experiment. Evidence of raw data logging must be included in an appendix to the main report.

There are two practical reports required for this module:

- One report requires the students to document the characteristics of a working telescope and instrument combination as a user manual, aimed at an amateur astronomy group or an astronomy student at level 2. The telescope chosen can be their own telescope and instrument combination or that of a professional telescope, whose information can be obtained from documentation provided on the web.
- A second report requires students to obtain and/or analyse electronic images using a telescope and electronic area detector combination. Data processing techniques will be used to illustrate how astronomical images are processed. The data will be used in an astronomical application to estimate physical properties, including realistic error estimates.

## LEARNING OUTCOMES

**On successful completion of this module a student will be able to:**

1.	Explain the principles of observational techniques and astronomical detectors including the physics of their operation for ultraviolet, optical and infrared wavelengths.
2.	Solve problems involving topics found in the syllabus.
3.	Select appropriate techniques and detectors for a variety of observational programmes.

4.	Extract and summarise relevant information from a given text or case study.
5.	Carry out a variety of quantitative observing and/or data reduction techniques at optical wavelengths.
6.	Record, analyse, present and report astronomical data with the aid of suitable software and IT packages.

### TEACHING AND LEARNING STRATEGY

This module may be studied by distance learning and consists of theoretical and practical material.

#### Theoretical material

Students will receive Distance Learning Course Notes and will be able to use email and the e-Learn site for tutorial support and case studies by means of the on-line discussion forums. Specific case studies enable students to see how the fundamental techniques apply both to observing with small telescopes and for professional use and will be used to illustrate current developments in satellite and ground-based telescopes and detectors. Tutorials based on the case studies will highlight the structure of scientific articles and emphasise the need for selectivity when reporting and summarising.

#### Practical material

Students will carry out observations and data analysis with guided support via e-Learn discussions and emails. This will also be supported by simulated experiments available via the Course Website. For this reason it is essential for distance learning students to have access to a PC with Internet access and to be prepared to download and install appropriate data analysis software. Experiments, data logging and formal reports are designed to develop the students' experimental/observational and transferable skills.

### INDICATIVE CLASS CONTACT

Interaction via e-Learn website discussions, including approximately monthly tutorial sessions.

### INDICATIVE ASSESSMENT

Assessment will be by coursework only, typically consisting of three compulsory components:

Number of Assessments	Assessment	Weighting %	Type/Duration/Wordcount (indicative only)	Learning Outcomes being assessed
1	Question sheet.	40%	Questions on the module material, including a short	1,2,3,4

			summary question.	
1	Case study report.	30%	Based on instrumentation.	1,3,4
1	Data analysis report.	30%	Based on imaging observations and their reductions.	4,5,6

### MODULE PASS REQUIREMENTS

It is necessary to obtain at least 30% in each item of coursework and an overall average mark of 40% or more is required to pass the module.

### BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL

Website: [www.studyastronomy.com](http://www.studyastronomy.com)

E-learn server: [Elearn.uclan.ac.uk](http://Elearn.uclan.ac.uk)

AA2053 Course Notes

*UVOIR Astronomy* Student Handbook

Recommended Text:

No single book covers all aspects of the course at the right level.

#### Supplementary Texts:

The supplementary texts include introductions and more advanced material.

Clarke, (2003), *Astronomy: Principles and Practice*, The Institute of Physics.

Kitchin, C.R., (2008), *Astrophysical Techniques* 5<sup>th</sup> ed., The Institute of Physics.

Kitchin, C.R., (2003), *Telescopes and Techniques: An introduction to Practical Astronomy*, Springer-Verlag UK,

McLean, I.S., (1996), *Electronic Imaging in Astronomy: Detectors and Instrumentation*, Wiley-Praxis Series in Astronomy & Astrophysics.

Rieke, (2003), *Detection of Light from Ultraviolet to the Submillimeter*, Cambridge University Press

Kirkup L, (1995) *Experimental Methods*, John Wiley and Sons Australia.

Publically available software:

Deep sky stacker

FITSView

<b>Module Title:</b>	<b>Exploring the Solar System</b>		
<b>Module Code:</b>	<b>AA2054</b>	<b>Module Level:</b>	2
<b>Module Tutor:</b>	Barbara Hassall/ Don Kurtz/	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	AA1055	<b>Semester:</b>	Year (DL) Sem 2 (Campus)
<b>Co-requisites:</b>	None		

### **Module Aims:**

This module provides an introduction to the Solar System complementing stellar and galactic work covered elsewhere in the Astronomy degree programmes. The course presents an up-to-date view of the Sun and planets in the Solar System, supported by video material, as well as images and results from recent space research. The course includes an overview of space exploration and the types of missions that led to our current understanding of our neighbouring planets. The Earth is examined as a planetary body. The discussion includes issues such as the development of the Earth's atmosphere, changes in climate, and the energy sources in and formation of the Solar System. Comparisons are made between the planets to highlight the similarities and differences with the emphasis on the critical analysis of the physical processes involved.

Students are normally expected to have prior elementary IT skills (*eg* through previous study of *AA1055 IT for Astronomy*) as these skills will be developed during study of this module.

### **Syllabus and Content:**

#### **Introduction**

An overview of the Solar System: its structure, scale and content.

#### **Overview of Space Exploration**

History, the motivation, technology, past present and future missions.

Methods of exploration: remote observation and space probes.

Prospects for future exploration and colonisation; mining mineral resources beyond the Earth. Outstanding questions in planetary studies.

#### **The Sun: our Nearest Star**

The Sun as the powerhouse of the Solar System: luminosity, size, mass, internal balance, and energy source. Fusion reactions: can we make them work on Earth? The missing solar neutrinos: a case study in how science works. Long-term stability and future evolution: how long will the Sun live? The Sun's atmosphere and solar activity: the sunspot cycle, solar flares and prominences; the solar wind.

#### **The Earth and Terrestrial Environment**

The Earth as a planet: atmosphere, surface, interior, magnetism, gravity. Evolution of the surface: volcanism and continental drift, erosion, cratering. Origin and evolution of the atmosphere; effect of solar radiation; the ionosphere; the biosphere; ice ages and long-term climatic change. Global effects of pollution: the ozone layer; greenhouse effect. Maintaining the environment. Sources of energy.

#### **The Planets and their Satellites**

The terrestrial planets: application of Earth sciences to other worlds. The giant planets as failed stars. Comparison of the properties of the planets and satellites: atmospheres, surfaces, interiors.

### History of the Solar System

Origin and history of the Sun and planets:

evidence from within the Solar System – comets, asteroids and other solar system debris; evidence from exoplanets studies of young stars.

### Teaching and Learning Strategy:

A *Study Guide* containing directed reading from recommended textbooks, internet resources, video and tv materials. This is supported by tutorials and discussions (in class and on-line) and introductory lectures for on-campus students. All students will have access to (e.g. through WebCT) self-test questions. The essay and presentation assessments will be prefaced by appropriate tutorial guidance on content and preparation.

- **On-campus students** will learn via lectures and tutorial sessions that will be supported by some of the educational resources available to the off-campus students.
- **Off-campus distant learning** students will learn via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule. Tutorial support for off-campus students will be provided by e-mail, electronic discussion groups and telephone. Students will be encouraged to participate in on-line or class discussions.

### Learning outcomes:

On successful completion of this module, students will be able to:

1. describe, compare and contrast the contents of the Solar System and the Sun
2. explain the processes underlying the similarities and differences between Earth and the other planets
3. discuss how space exploration contributes to our current understanding of the Solar System
4. collect and collate material from a variety of sources and write a substantial, coherent essay in this subject area
5. use IT software to prepare a concise (PowerPoint) presentation on a space mission or similar topic.

### Assessment Strategy:

Assessment is based on coursework only. There is no examination.

There are three assessments, typically:

- one question sheet containing a balanced mixture of questions
- preparation of a PowerPoint (or similar) presentation
- researched essay, 2,500-3,000 words

<i>Component</i>	<i>Typical Weighting</i>	<i>Assessed learning outcomes</i>
(1) Question sheet	40%	1,2
(2) Preparation of a IT presentation	20%	3,5
(3) Researched essay	40%	3,4

It is not necessary to pass each item of coursework individually provided that all three items have been attempted and the overall module mark is 40% or more.

***Bibliography and Learning Support Material:***

*Solar System Study Guide* and for Distance Learning, CD Rom.

WebCT server: [elearn.uclan.ac.uk](http://elearn.uclan.ac.uk)

*Study Guide* includes bibliography and WWW start-points for researched essay.

Distance Learning Website: <http://www.studyastronomy.com>

**Recommended Textbook:**

Beatty J. K., Peterson, C.C. & Chaikin, A., (eds) (1999) *The New Solar System*, 4th ed.

R.A.Freedman and W.J. Kaufmann III (2007) *Universe* 8th edition with CD ROM. W H Freeman, (paperback).

**Further recommended reading:**

Greerly, R. *Planetary Landscapes* 2<sup>nd</sup> ed., (1994) Kluwer Academic Publishers.

Phillips, K. J. H., (1992) *Guide to the Sun*, Cambridge University Press.

<b>Module Title:</b>	<b>Solar Astrophysics</b>		
<b>Module Code:</b>	<b>AA2055</b>	<b>Module Level:</b>	2
<b>Module Tutor:</b>	Silvia Dalla/ Robert Walsh	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	AA1051 or AA1058	<b>Semester:</b>	Year (DL)
<b>Co-requisites:</b>	None		

### ***Module Aims***

The aims of this module are:

- to provide a broad introduction to Solar Astrophysics, involving a mixture of theoretical and observational approaches to demonstrate and explain the various solar phenomena.
- to provide an understanding of physical laws and concepts as applied to Solar Astrophysics.
- to provide an understanding of the techniques for observing the sun.
- to develop the subject knowledge required for the module AA2056 for which it is a prerequisite.
- to provide the opportunity to develop techniques used in astronomy which have wider applications (eg data analysis, imaging techniques, preparation of scientific reports, and IT).
- to enhance the student's key skills.

### ***Syllabus and Content***

#### **1. Our Closest Star**

Sun's place in Universe; birth, life and death of the star; characteristics of the Sun; how we observe the Sun from space today (SOHO, TRACE)

#### **2. Probing the solar interior**

The inferno in the solar core: nuclear fusion; solar neutrinos and SNP; detection of solar interior oscillations: basic techniques in helioseismology; solar rotation and the Best Model Sun

#### **3. The Sun's magnetic personality**

Solar convection zone; the solar dynamo; the magnetic activity cycle; journeying into the photosphere

#### **4. Facing the universe**

The solar atmosphere (chromosphere, transition region, corona); spectral diagnostics of this environment- remote sensing of density, temperature and velocity

#### **5. The magnetised atmosphere**

Closed (loops) and open (coronal holes) magnetic fields; prominences; bright points; basic ideas in solar magnetohydrodynamics

#### **6. The coronal heating problem**

Outlining the coronal heating problem; solutions via (i) solar waves; (ii) breaking and rejoining magnetic field structures - reconnection

**7. The dynamic sun**

Solar flares; coronal mass ejections; predicting solar storms and their effect on space weather

**8. The future of solar astrophysics**

Outlining upcoming space-based solar missions; for example, currently Solar-B, STEREO, Solar Dynamics Observatory, Solar Orbiter; major outstanding research questions

***Teaching and Learning Strategy:***

**Distant learning** students will learn via self-study according to a Course Schedule, supported by detailed distance learning material supplied by the Department. The module requires about 200 hours of study. Each student will receive a CD Rom with *Course Notes* with worked examples and a *Workbook* containing self-test exercises and the assessed coursework. Additional material will be available, via the Course Website and the recommended course textbook, to supplement the examples given in the *Workbook*. The assignments contain questions to encourage students to solve conceptual and numerical problems. The approach is quantitative without taking a highly mathematical approach, but requires confident use of maths at about GCSE level (or equivalent high school qualification).

The experimental reports will be based on data sets provided to the student at the start of the course on the CD Rom and will involve data analysis and use of IT in their presentation to a high standard. Access to a PC with internet access is essential for this course

Tutorial support for off-campus students will be provided by e-mail, electronic discussion groups and telephone. Students will be encouraged to participate in on-line or class discussions.

You do not need a telescope or other specialist astronomical equipment to complete this course.

***Learning Outcomes***

On successful completion of this module, students will be able to:

1. describe solar phenomena and discuss the complexities of solar astronomy.
2. describe techniques for observing the sun
3. explain the physical principles and processes giving rise to solar phenomena
4. solve quantitative problems in this subject area
5. analyse solar data to investigate closed and open-ended problems.
6. write structured and coherent scientific reports of publication style.

***Assessment Strategy:***

Assessment will be by coursework only and there is no examination. There are four equally weighted items of coursework normally consisting of:

1. two question sheets covering the syllabus. Each is a balance of descriptive questions and simple problems

2. two activities involving data analysis and scientific report writing.

It is not necessary to pass each item of coursework individually provided that at least one question sheet and one Workbook Activity has been attempted and the overall module mark is 40% or more.

Components	Typical weighting	Assessed Learning Outcomes
(1,2) Question sheets	2 × 25%	1, 2, 3, 4
(3, 4) Experimental Reports	2 × 25%	4, 5, 6

### ***Bibliography and Learning Support Material***

Solar Astrophysics Course Notes for Distance Learning and CDRom.

Solar Astrophysics Workbook.

WebCT server: [Elearn.uclan.ac.uk](http://Elearn.uclan.ac.uk)

and Web Site: <http://www.StudyAstronomy.com>

#### **Recommended textbooks:**

Lang, K.R., (2001), *The Cambridge Encyclopedia of the Sun*, Cambridge University Press.

#### **Supplementary and further reading:**

Stix, M., (2003), *The Sun*, Springer-Verlag.

Dwivedi, B.N.(ed.), (2003), *Dynamic Sun*, Cambridge University Press.

Golub, L and Pasachoff, J.M., (2002), *Nearest Star: The Surprising Science of Our Sun*, Harvard University Press. Gribbin, J, (1992), *Blinded by the Light, the Secret Life of the Sun*, Black Swan.

[Zirker](#), J.B., (2002), *Journey from the Center of the Sun*, Princeton University Press.

Golub, L. and Paschoff, J.M., (1997), *The Solar Corona*, Cambridge University Press.

Green S. and Jones M.H.(ed.), (2004) *An introduction to the Sun and Stars*, Cambridge University Press.

<b>Module Title:</b>	<b>Solar-Stellar Connection</b>		
<b>Module Code:</b>	<b>AA2056</b>	<b>Module Level:</b>	2
<b>Module Tutor:</b>	Gordon Bromage/ Don Kurtz	<b>Module Size:</b>	Single
<b>Pre-requisites:</b>	AA2055	<b>Semester:</b>	Year (DL)
<b>Co-requisites:</b>			

### **Module Aims**

The aims of this module are:

- to provide an understanding of physical laws and concepts as applied to Solar Astrophysics.
- to link the level-2 study of solar astrophysics (AA2055) to a range of stellar phenomena and topics in stellar astrophysics, using the Sun as a detailed case study and setting it in the wider context of solar-like and other stars.
- to provide the opportunity to develop techniques used in astronomy which have wider applications (eg data analysis, imaging techniques, preparation of scientific reports, essay writing and IT).
- to enhance the student's key skills.

### **Syllabus and Content**

#### **1. The variety of stars**

The Sun in context: masses, compositions, spectral types and luminosities of stars. (Includes revision and review of relevant material from the *University Certificate in Astronomy*.) Variable stars and stellar evolution. Standard stars, variable stars, eruptive variable stars and cataclysmic variable stars.

#### **2. Solar-type stars and the main sequence**

Understanding the main sequence for solar-type stars. The Zero-Age Main Sequence and subsequent evolution within the main sequence for solar-type stars. The next 4 billion years of solar structure and evolution, and effects on the rest of the Solar System. Chemical composition of main-sequence stars. Population II solar-mass stars. The extent of the main sequence, top and bottom.

#### **3. Activity and adolescent stars**

Solar and stellar chromospheric and coronal activity. Solar-like flares and super-flares on late-type stars. Starspots and stellar coronae. Fast rotation, powerful coronae and high activity. Stellar structure and evolution just before and just after the main sequence. Violent outbursts of spotty adolescents. Close binaries and tidally-locked activity.

#### **4. Activity Cycles**

Solar and stellar activity cycles, observations and theory. The solar-stellar activity connection. Low-activity phases. Solar "twins". Radio, optical, UV and X-ray activity.

### **5. Music of the spheres**

The methods of helio-seismology and astero-seismology. Probing the internal structure. Asteroseismology of solar-type stars. Oscillations of early-type stars and peculiar stars. Present and future observational facilities and missions.

### **6. Early evolution**

The distant past in the solar system. Origins of the Sun and solar-type stars. The Sun as a protostar, a T Tauri star and a post-T Tauri star. The solar-stellar connection in galactic open clusters.

### **7. The far future**

The end of the main sequence: structure and evolution of solar-type stars as they leave the main sequence. The Sun as a red giant. Solar and stellar winds and mass loss in stars. Other types of giant stars. Even further into the future: the Sun and solar-type stars as planetary nebulae.

### **8. The end of the road**

What is a white dwarf? Pressure and degeneracy pressure. The Sun and solar-type stars as white dwarfs. Low-mass stars and brown dwarfs. The end state for more massive stars: neutron stars, pulsars and black holes. Solar-stellar connections and the astrophysics of the Galaxy.

### ***Teaching and Learning Strategy:***

Distance learning students will learn via self-study according to a Course Schedule, supported by detailed distance learning material supplied by the Department. The module requires about 200 hours of study. Course Notes are supplied on CDROM or can be downloaded from the Web, and are arranged in eight sections corresponding to the syllabus content summarised above. They include worked examples of problems and calculations. Tutorial support is provided via the Web (Web-CT), online discussion groups, email and telephone. Students will be encouraged to participate in on-line discussions.

Each student also receives a Workbook containing the assessed coursework assignments, and also self-test exercises with answers. Some of the assignments contain questions to encourage students to solve conceptual and numerical problems. The approach is quantitative without taking a highly mathematical approach, but requires confident use of maths at about GCSE level or equivalent high-school qualification.

The essay assignment will be prefaced by guidance on researching and writing a scientific essay. Finally, the on-line timed assignment will enable students to demonstrate understanding of the module material and provide logical summaries within short time constraints. Bearing in mind the possibility that students on this DipHE course may subsequently consider undertaking a BSc honours degree, this on-line timed assignment will also serve as practice for assessment by on-line examination in the future.

It is essential for students to have access to a PC and internet access to complete this module.

### ***Learning Outcomes***

On successful completion of the module, students will be able to:

1. describe or define concepts and astronomical terms from the syllabus and discuss observational data and links between solar and stellar astrophysics;
2. explain the physical principles and processes involved in solar and stellar astrophysics and basic stellar structure and evolution;
3. solve numerical problems in this subject area;
4. plan, research and produce a structured scientific essay in this subject area;
5. analyse conceptual problems, make inferences and provide reasoned arguments to justify conclusions drawn.

### **Assessment Strategy:**

There are four items of coursework normally consisting of:

1. two question sheets covering the syllabus. Each is a balance of descriptive questions and quantitative problems;
2. one scientific essay of approximately 1500 words;
3. one *timed* on-line open-book assignment.

It is not necessary to pass each assignment individually provided the essay, the timed assignment and at least one question sheet have been attempted, and provided the overall module mark is 40% or more.

Components	Typical weighting	Assessed Learning Outcomes
(1,2) Question sheets	20%, 25%	1,2,3
(3) Scientific essay	30%	2,4,5
(4) Timed assignment	25%	1,2,3

### **Bibliography and Learning Support Material**

Solar-Stellar Connection Workbook

WebCT (<http://elearn.uclan.ac.uk>)

Distance Learning Web Site ( <http://www.studyastronomy.com/> ).

Solar-Stellar Connection Course Notes for Distance Learning.

#### **Recommended textbook:**

No single textbook covers this module at the correct level. For background level 1 reading, Universe 8th edition is valuable.

R.A.Freedman and W.J. Kaufmann III (2007) *Universe* 8th edition with CD ROM. W H Freeman, (paperback).

#### **Supplementary and further reading:**

Suggested reading material will accompany specific sections of the Course Notes and for essay preparation, including:

- (a) selected extracts from *Annual Review of Astronomy and Astrophysics* (Annual Reviews, Palo Alto, California), and
- (b) review articles in proceedings of the series of solar-stellar connection workshops "Cool stars, stellar systems and the Sun" (Astronomical Society of the Pacific, Conference Series) volumes 26, 64, 109, 154 and 223.  
(<http://www.astrosociety.org/pubs/cs/confseries.html>)
- (c) "The solar-stellar connection: an overview", A.K. Dupree (2003),  
<http://origins.colorado.edu/cs12/proceedings/oral/monday/dupreeaxx.pdf>

## MODULE DESCRIPTOR

<b>MODULE TITLE</b>	Astrobiology		
<b>MODULE CODE</b>	AA2057	<b>CREDIT VALUE</b>	20 credits
<b>MODULE DELIVERY</b>	Year long		
<b>MODULE AUTHOR</b>	Ian Butchart		
<b>DATE APPROVED</b>	June 2005		

### RELATIONSHIP WITH OTHER MODULES

<b>Co-requisites</b>		<b>Pre-requisites</b>	AA1051 or equiv.
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### MODULE CONTENT

**History of astrobiology:** from Boyle and Lord Kelvin to space investigations.  
**Key stage to the development of life on Earth;** cells, chromosomes (genomes for cells), nucleic acids and proteins, endosymbiosis, genetic recombination, multicellularity, social organisation, civilization.

**Cosmic panspermia** (“seeds everywhere”), the hypothesis, evidence for, statistical arguments, magnetofossils (eg ALH84001), isotopically depleted graphite, electrochemical gradients. Transfers within the solar system.

**Origins of the elements,** initial chemistry in the universe, molecules and their detection. RNA and DNA, Catalogue of molecules and their environments.

**Interstellar dust and comets,** detecting organic molecules, (STARDUST probe), transferring molecules to Earth via dust and comets. Formation of dust. Content of comets – low and high temperature minerals, organic compounds.

**Origins of Life** –prebiotic materials and catalysts, use of clays as a template

**Habitable Planets;** introduction to stars, planets and their formation, formation of the Solar System, evidence for exoplanets, abundance and distribution of water.

**Life in the Solar System,** environments of Earth, Mars, Titan, Europa. Observations and remote sensing via space missions, Earth’s early biosphere, Evolution of life on Earth: Archaea, bacteria and eucarya.

**Evolution, Limits of Life,** importance of water and gravity, extremophiles,

**Life’s future on Earth and beyond,** Evolution, diversification, extinctions, impacts, supernovae, damage to the biosphere, seeding nearby planetary systems

**Signatures of Life;** current and future techniques within the solar system and in nearby planetary systems. Observational problems. Theory to determine the affect of microbial ecosystems on gases

**MODULE AIMS**

To introduce the inter-disciplinary connections between biology, chemistry and astronomy. It provides a description of the initial chemical composition of the universe and discusses how the evolution of the universe delivers heavier elements and molecules required to evolve life. The module also presents a detailed account of our knowledge of the development of life on Earth and discusses whether this is a common process elsewhere in the universe. Some of the problems of identifying and developing bio signature is discussed.

**LEARNING OUTCOMES**

**On successful completion of this module a student will be able to:**

1	describe the key components and conditions required to enable life to form.
2	discuss the development, diversity and survival of life in the universe
3	explain the difficulties in determining bio signatures to search for life beyond the solar system
4	plan, research and produce a structured scientific essay in this subject area
5	analyse conceptual problems, make inferences and provide reasoned arguments to justify the conclusions drawn.

**TEACHING AND LEARNING STRATEGY**

Off-campus distant learning students will learn via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule. Each student will receive Course Notes with worked examples and a Workbook. containing the assessed coursework and self-test exercises. Additional material will be available, via the Course Website and the recommended course textbook, to supplement the examples given in the Workbook. Some of the assignments contain questions to encourage students to solve conceptual and numerical problems.

**INDICATIVE CLASS CONTACT**

This module runs year-long and involves a total of 200 hours of study. Timetabled tutorials will be available on-line within WebCT.

**INDICATIVE ASSESSMENT**

Number	Assessment	Weighting %	Type/Duration/Wordcount (indicative only)	Assessed learning outcomes
2	Question sheets	2 x 30%	covering all areas of the syllabus	1,2,3,5
1	Researched Essay	40%	1,500 words	4,5

**MODULE PASS REQUIREMENTS**

It is not necessary to pass each item of coursework individually provided that the researched essay has been attempted and the overall module mark is 40% or more.

**BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL**

Iain Gilmour (ed) and Mark A Sephton (ed), *An Introduction to Astrobiology*, Cambridge University Press 2004, (ISBN-10: 0521546214 | ISBN-13 9780521546218) £30  
Jonathan Lunine, *Astrobiology: A Multi-Disciplinary Approach*, Publisher: Benjamin Cummings 2004, ISBN 0-8053-8042-6.£30,  
Andrew Shaw, *Astrochemistry: From Astronomy to Astrobiology*, Wiley 2006, ISBN 0470091371

**On-line Magazine**

*Astrobiology Magazine* <http://www.astrobio.net/>

**Additional Material (Journals)**

*International Journal of Astrobiology*, Publisher: Cambridge ISSN: 1473-5504  
*Astrobiology*, Publisher: Liebert, ISBN 1531-1074

*Origins of Life and Evolution of Biospheres*, Springer, ISSN: 0169-6149

## MODULE DESCRIPTOR

<b>MODULE TITLE</b>	<b>Astronomy Dissertation</b>		
<b>MODULE CODE</b>	<b>AA3050</b>	<b>CREDIT VALUE</b>	20 credits
<b>MODULE DELIVERY</b>	Year long		
<b>MODULE AUTHOR</b>	Barbara Hassall		
<b>DATE APPROVED</b>	August 2005		

### RELATIONSHIP WITH OTHER MODULES

<b>Co-requisites</b>	<b>AA3051</b>	<b>Pre-requisites</b>	
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### MODULE CONTENT

The dissertation is an extended piece of work that requires research by way of a literature search and/or web search of up-to-date material and approval to proceed will be based on the availability of appropriate learning resource and the possibility of effective supervision by a member of staff.

Students will select an area of interest and formulate an appropriate title from a list of astronomical topics similar to those encountered in current research projects. The chosen topic must be sufficiently focused to allow an indepth review of the topic and for the discussion to be at an advanced academic level.

### MODULE AIMS

Students are expected to conduct a detailed investigation of a chosen topic at an advanced level in liaison with an academic supervisor. The module aims are to:

- encourage the development of an independent study that is largely initiated and planned by the student and to see the work through to completion.
- write a substantial coherent report on an astronomical topic or theme.

### LEARNING OUTCOMES

**On successful completion of this module a student will be able to:**

<b>1</b>	use the library and internet resources to research a topic.
<b>2</b>	plan and carry out a piece of work with minimal supervision.
<b>3</b>	critically assess ideas and concepts and draw conclusions.
<b>4</b>	write a coherent structured report of a substantial piece of work.
<b>5</b>	use appropriate IT packages (Word processing and graphics) to produce a high quality written report.
<b>6</b>	give a presentation and answer specific questions on the dissertation with confidence and competence.

**TEACHING AND LEARNING STRATEGY**

This module is normally taken during the final year of study of the BSc (Hons).

After initial discussions at the start of the module, the student will be assigned a dissertation supervisor. Students will also receive a briefing document with guidance on the operation of the module, the production of the dissertation and the conduct of the viva. In collaboration with their supervisor, students must identify a theme from a short list of topics which they will explore.

In the sessions with their supervisor the student will be encouraged to develop an alertness to coherence of argument, precision in the interpretation of the text, clarity of style and methodological problems and solutions, exact and scrupulous observation of scholarly and bibliographical conventions and to practise presentations of their ideas. General progress will be monitored regularly throughout the module and the student will be expected to take on board ideas and input from the supervisor.

On completion of the dissertation, each student will be expected to participate in a viva in which they present a short summary of the work that they have undertaken and take part in a question and answer session on the content of the dissertation.

**Distance learning students** will learn via self-study according to a Module Schedule, Students will be expected to interact with their dissertation supervisor on a regular basis via email, telephone or WebCT. Distance Learning students will undertake their dissertation viva via telephone or video conferencing.

It is essential for Distance Learning students to have access to a PC and internet access to complete this module.

**INDICATIVE CLASS CONTACT**

This module runs year-long and involves a total of 200 hours of study. Students are expected to interact with their supervisors on a regular basis equivalent to a weekly 15-minute meeting.

**INDICATIVE ASSESSMENT**

Number	Assessment	Weighting %	Type/Duration/Wordcount (indicative only)	Assessed learning outcomes
1	Work Plan	5%	Approx 2 pages demonstrating planning and selection of topic	1,2
1	Dissertation Report	80%	Maximum 10,000 words	1,3,4,5
1	Viva voce or equivalent	15%	Approx 20 minutes	3,6

**MODULE PASS REQUIREMENTS**

Components do not have to be passed separately, as long as each is attempted and the overall module mark is over 40%.

In addition, students will be required to submit evidence of their work schedule in the form of an informal logbook or diary. The diary will be used as an independent check on the originality of the work in the dissertation and is therefore a *compulsory component*. The logbook or diary will not be awarded a formal mark.

**BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL**

*Dissertation and Viva Guidance Notes*  
LLRS and internet resources.

## MODULE DESCRIPTOR

<b>MODULE TITLE</b>	<b>Origins</b>		
<b>MODULE CODE</b>	<b>AA3051</b>	<b>CREDIT VALUE</b>	20 credits
<b>MODULE DELIVERY</b>	Year long		
<b>MODULE AUTHOR</b>	Gordon Bromage/Barbara Hassall/Ian Butchart		
<b>DATE APPROVED</b>	August 2005		

### RELATIONSHIP WITH OTHER MODULES

<b>Co-requisites</b>		<b>Pre-requisites</b>	
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### MODULE CONTENT

This module is based on a selection of topics that are drawn from those projects that are regarded as “cutting edge research” in astronomy or astrophysics. In general the module will concentrate on the topics that are likely to be featured in the media or play an important role in national research programmes.

Origins of:-

- The universe (including the large scale structure and dark matter)
- Life in the Universe
- Stars
- Planetary systems

Large astronomical instrumentation (e.g. new telescopes, satellites, detectors.)

Computational infrastructure for astronomy (e.g. Astro-grid).

### MODULE AIMS

This Level 3 module presents the scientific highlights of current astronomical investigation. To allow students to:

- learn about the astronomical projects that the scientific community sees as important or fundamental research areas.
- conceptually understand and gain an insight into the scientific method for investigating problems.
- learn about the technological advances that are required to participate in major science projects.
- maintain a portfolio of work on current topics in astronomy or astrophysics.

### LEARNING OUTCOMES

**On successful completion of this module a student will be able to:**

<b>1</b>	analyse the scientific motivation for current initiatives in astronomy research.
<b>2</b>	analyse how scientific objectives drive the planning and development of major research programmes.
<b>3</b>	prepare a critical literature review of a current research topic.
<b>4</b>	critically assess information and concepts and draw conclusions from them.
<b>5</b>	use IT resources at a high level to deliver a scientifically mature seminar.
<b>6</b>	summarise and communicate scientific ideas.

**TEACHING AND LEARNING STRATEGY**

This module will be delivered by lectures and by student self-study whereby the students are encouraged to develop self-discipline and motivation. Rather than focusing on the visible detail of a specific problem students will be encouraged to develop a broad perspective on the topics and will be encouraged to formulate generic/general strategies for solving problems.

Each student will research and deliver a seminar. Students will be expected to keep an up-to-date portfolio of all the seminars. In addition to encouraging attendance, the portfolio should show 'added value' to any seminar handouts (eg through reflective annotations, a summary of the class discussion highlighting the student's personal contribution to the discussion etc). Each student will normally write up six student seminars, typically one every two weeks.

This module includes an examination, which enables students to demonstrate understanding of the module material and provide logical summaries within short time constraints. The preparation for the examination allows the students to draw together themes and concepts and consolidate their academic knowledge of astronomy.

The essay will aid this consolidation and give students practice in critical analysis of one or more of these topics. Students will be given tutorials in how to tackle examination questions and will practise at examination style questions.

**Distance learning students** will learn via self-study according to a Module Schedule, supported by distance learning material supplied by the Department via WebCT. To fulfil the group seminar aspects of the module, students will be required to participate in on-line discussions in classroom meetings and via the noticeboards. The WebCT student presentation facility will be used to enable students to see each others' seminars and contribute to class discussion.

The formal presentation will be submitted electronically with full referencing and notes of the commentary to accompany each slide.

Finally, for distance learning students, the examination will be the same as for the on-campus students, but implemented in the form of an "on-line" timed assignment. Comparison of the style of their timed assignment with work previously submitted online will be used to check that the submission is entirely the student's own work.

It is essential for distance learning students to have access to a PC and internet access to complete this module.

**INDICATIVE CLASS CONTACT**

The module requires about 200 hours of study, including class interactions and private study.

On-campus students attend lectures/seminars for 2 hours per week.

Distance learning students interact via timetabled tutorials and on-line discussions in WebCT.

**INDICATIVE ASSESSMENT**

Number	Assessment	Weighting %	Type/Duration/Wordcount (indicative only)	Assessed learning outcomes
1	Examination/Timed online assignment	50%	3 hours	1,2,4
1	Seminar Presentation	15%	20 mins	4,5,6
1	Critical/analytical essay	20%	2 hours	3,4,6
1	Portfolio of student seminars	15%	Write-ups of about 6 seminars	4,6

**MODULE PASS REQUIREMENTS**

It is not necessary to pass each item of coursework individually provided that all three components have been attempted and the overall coursework mark is 40% or more. To pass the module, the composite mark must be 40% or more, and examination mark must be greater than 30%.

**BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL**

WebCT server: [elearn.uclan.ac.uk](http://elearn.uclan.ac.uk)

**Recommended textbook:**

LLRS and internet resources.

Northedge, A., Thomas, J., Lane, A., & Peasgood, A., (1997) *The Sciences Good Study Guide*, The Open University Press.

**Suggested further reading:**

Research journals such as *Ann. Rev. of Astronomy and Astrophysics*.

Case studies e.g. the scientific input to VISTA and SALT telescopes.

## MODULE DESCRIPTOR

<b>MODULE TITLE</b>	<b>Cosmology and Relativity</b>		
<b>MODULE CODE</b>	<b>AA3053</b>	<b>CREDIT VALUE</b>	20 credits
<b>MODULE DELIVERY</b>	Year long		
<b>MODULE AUTHOR</b>	Tim Cawthorne/Roger Clowes		
<b>DATE APPROVED</b>	June 2005		

### RELATIONSHIP WITH OTHER MODULES

<b>Co-requisites</b>		<b>Pre-requisites</b>	AA1053, AA1056
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### MODULE CONTENT

#### Relativity

##### Special Relativity

The demise of Galilean relativity, Lorentz transformations, velocity transformations, relativistic Doppler effect, transverse Doppler effect, mass, energy and momentum, four-vectors, invariants, dynamics. Applications in astronomy – stellar aberration, cosmic rays – confinement by galactic magnetic fields, interaction with Cosmic Background Radiation, muon half-life.

##### General relativity (GR)

The equivalence principle, the metric, geodesics, curvature of space. Observational confirmation of GR: including gravitational redshift, deflection of light precession of perihelion of Mercury's orbit, what GPS can do for GR.

Gravitational lensing, Einstein ring, applications to cosmology (eg masses of lensing objects, path differences and time delays to measure  $H_0$ , microlensing)

##### Cosmology

Review of fundamental observations: Olber's paradox, recession of galaxies, Hubble's law, isotropy and homogeneity, the Cosmological Principle. Cosmic microwave background, Sunyaev-Zeldovich effect, acoustic peaks, polarization. The Robertson-Walker metric, distances and luminosities. Dynamics of the hot big bang model,  $H_0$ . The fluid equation and Friedmann equation, Models for the Universe. The Cosmological Constant.

The history of the Universe: particles in the early universe and relationship with the 'standard model', symmetry breaking, matter and antimatter, synthesis of the elements, recombination. Inflation, acoustic waves. Recent developments including the accelerating universe and dark energy.

Beyond the standard model: An introduction to superstrings, branes, chaotic inflation, MOND.

### MODULE AIMS

To build upon the *Introduction to Cosmology* provided by AA1053, by introducing a mathematical approach to Cosmology and Relativity.

To present the essentials of cosmology and relativity, emphasising the underlying physics and the observational consequences.

**LEARNING OUTCOMES**

**On successful completion of this module a student will be able to:**

1	Describe and explain the fundamental observational and experimental results in the fields of Cosmology and Relativity.
2	Explain the ideas and principles used to interpret these results.
3	Analyse and solve problems relating to Cosmology and Relativity.
4	Critically assess ideas and results and draw conclusions.
5	Communicate complex ideas in a scientifically mature manner.

**TEACHING AND LEARNING STRATEGY**

Off-campus distance learning students will learn via self-study, supported by detailed distance learning material supplied by the Department according to a Course Schedule.

Each student will receive Course Notes with worked examples and a Workbook containing the assessed coursework and self-test exercises. Additional material will be available via the Course Website and the recommended course textbook, to supplement the examples given in the Workbook. Some of the assignments contain questions to encourage students to solve conceptual and numerical problems. The critical review assignment will be prefaced by guidance on researching and writing a scientific essay.

**INDICATIVE CLASS CONTACT**

Distance learning – Contact with tutor and students via WebCT discussion board and monthly on-line classroom sessions.

Tutorial support for off-campus students will be provided by e-mail, electronic discussion groups and telephone. Students will be encouraged to participate in on-line or class discussions.

**INDICATIVE ASSESSMENT**

Number	Assessment	Weighting %	Type/Duration/Wordcount (indicative only)	Assessed learning outcomes
2	Question Sheets	2x35%	A balance of conceptual question and mathematical problem-solving.	1,2,3,4
1	Critical Review	30%	1500 words	4,5

**MODULE PASS REQUIREMENTS**

It is not necessary to pass each item of coursework individually provided that the critical review has been attempted and the overall module mark is 40% or more.

**BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL****Recommended**

Liddle, A. (2003) *An Introduction to Modern Cosmology*, 2<sup>nd</sup> edition, Wiley, (first edition is out of date and no longer suitable).

**Background**

French, A. P. (1968) *Special Relativity*, Norton, (other editions would also be suitable)

Green, (2000) *The Elegant Universe: Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory*, Random House, ISBN: 0375708111

MJ Rees, (2004) *Just Six Numbers: The Deep Forces That Shape the Universe*, Phoenix mass market ISBN: 0753810220.

Roos, M., (2003) *Introduction to Cosmology*, 3<sup>rd</sup> Edition Wiley. ISBN: 047084910X

## MODULE DESCRIPTOR

<b>MODULE TITLE</b>	<b>Extreme States of Matter</b>		
<b>MODULE CODE</b>	<b>AA3056</b>	<b>CREDIT VALUE</b>	20 credits
<b>MODULE DELIVERY</b>	Year long		
<b>MODULE AUTHOR</b>	Ian Butchart /Barbara Hassall		
<b>DATE APPROVED</b>	August 2005		

### RELATIONSHIP WITH OTHER MODULES

<b>Co-requisites</b>		<b>Pre-requisites</b>	AA1056, AA1051
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### MODULE CONTENT

**Thermodynamics:** classical thermodynamics, temperature, entropy, heat, equilibrium, radiation. Black Holes, horizon, application of thermodynamics to black holes, pair production and evaporation from BH, rotating BH, time reversal of BH.

**Quantum and Statistical Mechanics:** wave-particle duality, particle in box, density of states, Fermi Energy, degenerate matter, relativistic and non-relativistic cases, degenerate equations of state and their application to WD and NS. He-flash in stellar cores.

**Nucleosynthesis:** origin of the elements, problems with production of heavy elements, binding energies, neutron-capture, cross-sections, beta-decay, s process abundances, r process abundances massive stars and SN events, mass loss in AGB stars and Planetary Nebulae, novae.

**Emission Mechanisms:** electromagnetic radiation, astrophysical plasma, bremsstrahlung, cyclotron, synchrotron, masers, radiative transfer. Applications in jets, novae, accretion disks, Eddington limit.

**Spectroscopy and its applications:** dipole and quadrupole radiation, absorption and emission processes, forbidden lines. Examples of astrophysical spectra.

**Gravitational Radiation:** production of gravitational waves, quadrupole mechanism, inverse square law geometric dilution of gravitational waves, frequency spectrum. Interaction with matter/cross-section for absorption. Sources of gravitational waves (energy/frequency plot), gravitational wave detectors, results so far.

### MODULE AIMS

This module covers in depth a limited number of physical concepts that describe the behaviour of matter in extreme conditions using astrophysical examples to illustrate the concepts.

The module extends both the mathematics and physics introduced in *AA1056 Matter, Energy and the Universe*. Many of the astrophysical examples are taken from across the programme, but with more rigorous physical and mathematical treatment.

This module contains the ground-work to enable the student to proceed with further study.

**LEARNING OUTCOMES**

**On successful completion of this module a student will be able to:**

1	use advanced mathematics to describe astrophysical processes or circumstances.
2	explain the behaviour of astrophysical phenomena using advanced physics concepts.
3	use mathematical techniques and physical concepts to model astrophysical objects.
4	use observational evidence to test the predictions of mathematical models.
5	solve advanced problems associated with topics on the syllabus and derive numerical results or estimates.

**TEACHING AND LEARNING STRATEGY**

This module will be taught using detailed course notes, self-test problems and problem/question sheets which will be used for feedback and assessment. Each syllabus topic is expected to span two sections of the course notes; the first will concentrate on the physics and mathematics and the second will use the material to describe an astrophysical example.

**INDICATIVE CLASS CONTACT**

This module involves 200 hours of study. For distance learning students this will be home study supported by timetabled tutorials and discussion within WebCT.

**INDICATIVE ASSESSMENT**

Number	Assessment	Weighting %	Type/Duration/Wordcount (indicative only)	Assessed learning outcomes
3	Questions/Problems	3 x 25%	Mainly problems involving maths/physics application to Astrophysics.	1,2,3,4,5
1	Timed on-line test	25%	3 hour.	1,2,3,4,5

**MODULE PASS REQUIREMENTS**

The overall pass mark for this module is 40% with minimum thresholds of 30% in the timed test and average of all three Question/Problem assessments. All assessments including the timed on-line assessment must be attempted.

**BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL**

**No single book covers all topics in this module.**

**Further Reading:-**

Neb Duric, *Advanced Astrophysics*, Cambridge CUP 2004 (also available as an e-book).

Malcolm S Longair, 1992 *High Energy Astrophysics: Particles, Photons and their Detection*. Vol 2 Cambridge CUP 1992

Malcolm S Longair, 1994 *Stars, the Galaxy and the Interstellar Medium*. Vol 2, Cambridge CUP 1992

## MODULE DESCRIPTOR

<b>MODULE TITLE</b>	<b>Collaborative Investigation</b>		
<b>MODULE CODE</b>	<b>AA3057</b>	<b>CREDIT VALUE</b>	20 credits
<b>MODULE DELIVERY</b>	Year long		
<b>MODULE AUTHOR</b>	Barbara Hassall/Brad Gibson		
<b>DATE APPROVED</b>	August 2005		

### RELATIONSHIP WITH OTHER MODULES

<b>Co-requisites</b>		<b>Pre-requisites</b>	<b>AA1057</b>
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### MODULE CONTENT

There is no specific syllabus for this module. Students will research and study a current scientific topic that is appropriate to their degree programme.

#### Examples of possible Group Study topics are:

- Earth observation for climate/pollution monitoring
- Planning a major ground based observing facility
- Writing a scientific observing proposal for a major telescope
- Topics in binary stars
- The Star SS433
- Future Astrophysics or Solar System Space Missions
- Developing vehicles for interstellar travel
- Educational issues/national outreach programmes in Astronomy
- International collaborations in Astronomy to provide ground-based and space facilities.

### MODULE AIMS

The aim of the module is to develop the student's skills in group working, using library and other resources, report writing and IT-based presentation skills. The mode of collaboration through electronic communication mirrors the way in which many professional astronomers undertake their research. This module builds explicitly on the individual research skills introduced in *AA1057 Investigations in Astronomy*, and requires a high level of IT expertise such as through previous study of *AA1055 IT for Astronomy*.

Students will use library and internet resources and acquire information on a current scientific topic to evaluate it and its relevance to their study area. Students will collaborate with other group members, sharing information and working towards common aims and objectives. Each student will be assigned an administrative role within the team and will jointly agree to share the investigative aspects of the study.

### LEARNING OUTCOMES

**On successful completion of this module a student will be able to:**

<b>1</b>	work as a team member towards common aims and objectives, meeting the teams' self imposed deadlines.
<b>2</b>	collect and collate information that is relevant to the team project.
<b>3</b>	exercise scientific judgement on material.
<b>4</b>	make a significant (and integrated) contribution to a team presentation.
<b>5</b>	make a significant independent and integrated contribution to the common report.

### TEACHING AND LEARNING STRATEGY

**Distance learning students** will learn via self-study according to a Module Schedule, supported by distance learning material supplied by the Department via WebCT Tutorial support is provided via the Web (Web-CT), online discussion groups, email and telephone.

To fulfil the groupwork aspects of the module, students will be required to participate in on-line discussions in classroom meetings and via the noticeboards. The WebCT student presentation facility will be used to enable students to take part in group meetings and contribute to class discussions.

Students will learn through:

- weekly formal on-line group meetings that are also attended by a group supervisor and
- independent/team work to collect and collate information relevant to the selected topic.

Each student will have a particular role within the team and will be expected to execute the tasks assigned in the formal meetings. Priorities and scope of the investigation will be the collective responsibility of the team.

Students will also be expected to undertake private study to complete tasks to bring forward to the next group meeting. During this study period each student is expected to work for the collective good of the team feeding relevant information to other team members and where necessary taking the initiative to bring new ideas into the group study. Each group member will be expected to meet the objectives set by the group in the formal group meetings.

The group work will be supported by on-line resources and exercises to develop students' skills in: researching material, information retrieval, specialist IT skills, conducting meetings, writing up minutes of meetings, role of logbooks and supervisor and project management.

The entire team will be working towards common goals:

- to produce a professional group presentation – to be submitted on-line with full references and commentary to accompany each slide
- to produce a common scientific report
- to produce other documentary evidence of work done (eg in form of minutes of meetings).

### INDICATIVE CLASS CONTACT

The module requires about 200 hours of study, including class interaction and private study. On-line group meetings will take place each week.

### INDICATIVE ASSESSMENT

Number	Assessment	Weighting %	Type/Duration/Wordcount (indicative only)	Assessed learning outcomes
1	Work done and contribution to group effort	30%	Assessed by peer group	1,2,4,5
1	Final Report	40%	10-15 pages per student, Assessed by Group Supervisor	2,3,5
1	On-line Presentation	30%	Equivalent to about 8 minutes per student Assessed by Course Team	3,4

### MODULE PASS REQUIREMENTS

Each student is allocated an individual mark for their contributions to the Report and Presentation. Components do not have to be passed separately, as long as each is attempted and the overall module mark over 40%.

### BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL

**Recommended Text:**

Alley, M (1996), *The Craft of Scientific Writing*, 3e, Springer-Verlag

**Further guidance** will be provided in Module Handbook.

Web resources (e.g. NASA websites), Library Journals.

University's study skills website.

