Module Catalogue

Astronomy

StudyAstronomy.com

School of Computing, Engineering and Physical Sciences
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BSc (Hons) Astronomy (by Distance Learning)

Level 4

Level 5

Level 6

Module Level Descriptors

The higher education levels operated in the University are drawn from the national credit consortia guidelines. Further education provision covers a range of pre-degree levels. Individual disciplines will also refer to subject benchmarks in determining level:

Level 1 (FE): Craft level
Level 2 (FE): GCSE/O/(G)NVQ level 2
Level 3 (FE): A/AS/AVCE/NVQ level 3

Within the higher education context the following level descriptors provide a broad outline of general learning outcomes. At a specific level students should be able to demonstrate that they can:

Level 4 (HE) (Year 1 undergraduate)
Develop a rigorous approach to the acquisition of a broad knowledge base and a range of subject specific, cognitive and transferable skills; understand key concepts and theories; evaluate the appropriateness of different approaches to solving problems and communicate the outcomes clearly using structured arguments.

Level 5 (HE) (Year 2 undergraduate)
Apply and critically evaluate key concepts and theories within and outside the context in which they were first studied; select appropriately from and deploy a range of subject specific cognitive and transferable skills and problem-solving strategies to well defined problems in the field of study and in the generation of ideas; effectively communicate information and arguments in a variety of forms.

Level 6 (HE) (Honours degree)
Critically review, consolidate and extend a systematic and coherent body of knowledge; critically evaluate new concepts and evidence from a range of sources; transfer and apply subject specific, cognitive and transferable skills and problem-solving strategies to a range of situations and to solve complex problems; communicate solutions, arguments and ideas clearly and in a variety of forms.

Level 7 (HE) (Masters)
Display mastery of a complex and specialised area of knowledge and a critical awareness of issues at the forefront of the area of study; employ advanced subject specific and cognitive skills to enable decision-making in complex and unpredictable situations, the generation of new ideas and support the achievement of desired outcomes.

Level 8 (HE) (Doctorate)
Make a significant and original contribution to a specialised field of inquiry demonstrating a command of methodological issues and engaging in critical dialogue with peers; accepting full accountability for outcomes.

Supporting Documents:

- Higher Education Credit Framework for England: guidance on academic credit arrangements in higher education in England which is available from the QAA website: http://www.qaa.ac.uk/england/credit/creditframework.pdf

- Framework for Higher Education Qualifications, guidance on level descriptors for HE awards, available from the QAA website. http://www.qaa.ac.uk/academicinfrastructure/FHEQ/EWNI08/FHEQ08.pdf

MODULE TITLE	**Introduction to Astronomy**		
MODULE CODE	AA1051 (L4)	**CREDIT VALUE**	20 Credits
MODULE DELIVERY	On-campus– year long Distance learning – year long		
PATTERN OF DELIVERY	On-campus - Weekly lectures - *Formal lectures delivered weekly. Laboratory (Observing) delivered weekly over 12 weeks from the end of October.* Distance Learning - Course schedule		
MODULE TUTOR	Ian Butchart, Gordon Bromage, Don Kurtz		
DATE APPROVED	12 April 2011	**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**	**N/A**

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**None**	**Excluded Combinations**	**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. 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.

MODULE CONTENT

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; astronomical imaging; imaging and analysis of the moon's surface structure; Schmidt Plate Investigation; Computer Assisted Learning Packages; stellar

classification; Plotting a Hertzsprung-Russell diagram for stars.

LEARNING OUTCOMES

On successful completion of this module a student will be able to:	
1.	describe or define concepts and astronomical terms from the syllabus and so demonstrate a broad awareness of simple 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)

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

ON-CAMPUS STUDENTS.

Students are presented 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.

- **On-campus students** will learn mainly in the classroom through lectures, teaching sessions and tutor led discussions. Private study will also be necessary to supplement the classroom sessions. Subject material will be provided as formal lectures and regular tutorials in the classroom. Students will have the opportunity to use Alston Observatory one night per week over the equivalent of one semester.

DIRECT CONTACT HOURS	**No of hours**
Lectures	48
Labs	24
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	72
INDEPENDENT LEARNING HOURS	
Working through details of lecture material	52
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	128
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

LEARNING, TEACHING AND ASSESSMENT STRATEGY

DISTANCE LEARNING

Students are presented 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 Course Team according to a Course Schedule. Each student will have available: *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.
  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.

DIRECT CONTACT HOURS	**No of hours**
Online tutorial	6
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of course materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
2	Experimental Report	*2 x 25%*	10 pages	3,4,5
2	Question Sheet	*2 x 25%*	10 Questions and Problems	1,2

MODULE PASS REQUIREMENTS

It is not necessary to pass each item of assessment individually provided that at least one Question Sheet and one Experimental Report has been attempted and the overall module mark is 40% or more.

BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL

Astronomy Workbook and Web Site (WebCT and http://www.StudyAstronomy.com).
Course Notes for Distance Learning.

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

Freedman , R.A., Geller R & Kaufman, W. J., (2010) *Universe* 9th ed., W. H. Freeman.

Norton, A.R., (1998), *Norton's Star Atlas: And Reference Handbook,* Pitman Pub

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., Donner, K.J. (Eds) (2007) *Fundamental Astronomy, 5th edition.* Springer Verlag.

MODULE TITLE	**Introduction to Cosmology**				
MODULE CODE	AA1053 (L4)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Roger Clowes				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**None**	**Excluded Combinations**	**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. 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.

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.

MODULE 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

LEARNING OUTCOMES

On successful completion of this module a student 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

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

- **Distance Learning students** will learn via self-study, supported by detailed distance learning material supplied by the Course Team 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-line and a Personal Computer with internet access is required.
- Tutorial support will be provided by e-mail, on-line discussion groups (e.g. via the website and WebCT) and telephone.

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
TOTAL CONTACT HOURS (At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
2	Question Sheets Mixed problems and questions	2 x 33.33%	10 questions/problems	1,2,3
1	Scientific Essay	1 x 33.33%	800-1000 words	3,4,5

MODULE PASS REQUIREMENTS

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

WebCT server: elearn.uclan.ac.uk

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

RECOMMENDED TEXTBOOK:

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

Suggested further reading:

Harrison, E. (2000) Cosmology, 2nd Edition, Cambridge University Press.

MODULE TITLE	**IT for Astronomy**				
MODULE CODE	AA1055 (L4)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year-long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Stewart Eyres Ian Butchart				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**AA1051 or AA1053**	**Excluded Combinations**	**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.

MODULE 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.

LEARNING OUTCOMES

On successful completion of this module a student 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).

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT 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.	
DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT
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 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.

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
1	*Scientific document preparation*	*20%*	*10 pages*	*1,2,4*
1	*Web-page report of software installation*	*40%*	*2000 words*	*1,2,3*
1	*Electronic presentation of seminar*	*40%*	*7-15 slides equivalent to 15 minute presentation.*	*2,3,5*

MODULE PASS REQUIREMENTS

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 the WebCT server: 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:

Freedman , R.A., Geller R & Kaufman, W. J., (2010) *Universe* 9th ed., W. H. Freeman.

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.

MODULE TITLE	**Energy, Matter and the Universe**				
MODULE CODE	AA1056 (L4)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Silvia Dalla Barbara Hassall				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	AA1051 or GCSE Maths	**Excluded Combinations**	**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 5 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

MODULE 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

LEARNING OUTCOMES

On successful completion of this module a student 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

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY Students will learn by applying physical concepts to astronomical processes via self-study, supported by detailed distance learning material supplied by the Course Team according to a Course Schedule. Each student will use *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-line and a Personal Computer with internet access is required. The distance learning website provides additional learning materials and guidance in using the supplied materials and in applying the material in a wider context.	
DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

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

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

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
2	*Question Sheets*	*2 x 33.33%*	*8-10 problems*	*1,2*
1	*Question Sheet with Open-ended problem*	*33.33%*	*4-6 problems + Open-ended problem*	*3*

MODULE PASS REQUIREMENTS

It is not necessary to pass each item of coursework individually provided that the Question Sheet with 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, CDRom.

WebCT server: elearn.uclan.ac.uk

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

Recommended textbook:
Tipler, P.A. and Mosca, G., (2008), Physics for Scientists and Engineers, Extended Version, 6th edition, 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*, 4th Ed. Saunders College Publishing.

MODULE TITLE	**Investigations in Astronomy**				
MODULE CODE	AA1057 (L4)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Stewart Eyres Ian Butchart				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	AA1055 or equivalent	**Pre-requisites**	AA1051 and AA1053 or equivalent	**Excluded Combinations**	**None**

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.

MODULE 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

LEARNING OUTCOMES

On successful completion of this module a student 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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT 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.

Students must have access to a Personal Computer with Internet access.

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

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.

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
1	Topic 1	25%	1,000 words	2,3,4
1	Topic 2	30%	1,600 words	1,3,4
1 1	Topic 3 report Topic 3 on-line presentation	35% 10%	2,500 words 7-10 slides (equivalent to 10 minute presentation)	1,3,4,5

MODULE PASS REQUIREMENTS

It is not necessary to pass each item of coursework individually provided that all items 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.

WebCT server: elearn.uclan.ac.uk

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

Students will have access to electronic library facilities.

MODULE TITLE	**Sun, Earth and Climate**		
MODULE CODE	AA1058 (L4)	**CREDIT VALUE**	20 Credits
MODULE DELIVERY	Distance Learning – year long		
PATTERN OF DELIVERY	DL course schedule		
MODULE TUTOR	Silvia Dalla/Robert Walsh		
DATE APPROVED	12 April 2011	**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**	**N/A**

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**None**	**Excluded Combinations**	**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.

MODULE 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.

LEARNING OUTCOMES

On successful completion of this module a student 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)

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

Course Notes are supplied on-line 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.

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-line, but may be supplemented by data from the web.

It is indispensable for students to have access to a PC with internet access.

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
2	*Question Sheets including problems and descriptive questions.*	*2 x 25%*	*10 questions*	*1,2*
2	*Experimental reports*	*2 x 25%*	*10-15 pages*	*3,4,5*

MODULE PASS REQUIREMENTS

It is not necessary to pass each item of coursework individually provided that at least one question sheet and one Experimental Report 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.
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* 9th edition will find the chapters on the Sun and Earth useful:

Freedman , R.A., Geller R & Kaufman, W. J., (2010) *Universe* 9th ed., 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,* 2nd Edition, Freeman.

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

MODULE TITLE	**Introduction to Astrobiology**				
MODULE CODE	AA1059 (L4)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Ian Butchart and Stewart Eyres				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**None**	**Excluded Combinations**	**None**

MODULE AIMS

This module presents an introduction to astrobiology including the basic knowledge of chemistry and astronomy appropriate for the understanding of the biochemistry under pinning 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 The student will be able to develop appropriate skills and techniques, which will have a wider application in scientific work and other fields.

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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

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

Each student will use 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 of 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

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	Form of Assessment	% weighting	Size of Assessment/Duration/ Wordcount (indicative only)	Learning Outcomes being assessed
2	*Question/ Problem sheets*	*2 x 25%*	*10 questions*	*1,2,4*
2	*Report on scientific experiment*	*20%+30%*	*10-15 pages*	*3,4*

MODULE PASS REQUIREMENTS

To pass the module students must attempt at least one problem sheet and one experimental report and obtain an average mark of at least 40%.

BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL

AA1059 Introduction to Astrobiology, Course Notes, uclan

Recommended text book

Rothery, David A., Gilmour, Iain and Sephton, Mark A, 2011 *An Introduction to Astrobiology 2nd Edition,* Cambridge University Press

Further Reading

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.

MODULE TITLE	**Great Astronomers in History**				
MODULE CODE	AA1066 (L4)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Paul Marston/Gordon Bromage				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**None**	**Excluded Combinations**	**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.

MODULE 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, Pythgoreanism, and rationalism as enduring approaches within science. Platonism: mathematics, permanence, ideal forms and the unrealiabity 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 Copenicus.

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 Bellarmine'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?

LEARNING OUTCOMES

On successful completion of this module a student 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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY
Students will learn via self-study, supported by detailed distance learning material supplied by the Course Team according to a Course Schedule. Each student will use *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).

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

Students require a PC with internet access.

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	Form of Assessment	% weighting	Size of Assessment/Duration/ Wordcount (indicative only)	Learning Outcomes being assessed
1	Book review	25%	1000-1500 words	1,4
1	Role play letter	25%	1000-1500 words	1,4
1	Essay	50%	3000-3500 words	2,3,4

MODULE PASS REQUIREMENTS

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

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

WebCT server: 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 – 2nd 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.

MODULE TITLE	**The Milky Way**				
MODULE CODE	AA2051 (L5)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Victor Debattista / Gordon Bromage				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**AA1051**	**Excluded Combinations**	**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.

MODULE 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.

LEARNING OUTCOMES

On successful completion of this module a student 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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY
Distance learning students will learn via self-study, supported by detailed distance learning material supplied by the Course team according to a Course Schedule.

Each student will use *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 discussions.

Students require a PC with internet access.

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
2	*Question sheets (numerical and conceptual questions)*	*30%, 35%*	*5 questions*	*1,2,3*
1	*Scientific Essay*	*35%*	*1,500 – 2,000 words*	*2,4,5*

MODULE PASS REQUIREMENTS

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.

WebCT server: elearn.uclan.ac.uk

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

Recommended Textbook:
Sparke, L.S, & Gallagher, J.S., (2007), *Galaxies in the Universe,* 2nd 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.

MODULE TITLE	**Galaxies Beyond the Milky Way**				
MODULE CODE	AA2052 (L5)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Anne Sansom/ Gordon Bromage				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**AA1051** **AA2051**	**Excluded Combinations**	**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.

MODULE 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

LEARNING OUTCOMES

On successful completion of this module a student 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*).

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

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

Each student will have access to *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*.

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	Form of Assessment	% weighting	Size of Assessment/Duration/ Wordcount (indicative only)	Learning Outcomes being assessed
1	Question sheet (numerical and conceptual)	30%	5 questions	1,2,3
1	Data Analysis and Report (Use of web database resources to carry out multi-waveband analysis of a galaxy and present the results in a report.)	40%	6-10 pages	4,5,6,7
1	Summary of Article (such as from New Scientist, Scientific American or a review article available on the web.)	30%	2-4 pages	6,7

MODULE PASS REQUIREMENTS

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.

WebCT server: elearn.uclan.ac.uk

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

Recommended Textbook:
Sparke, L.S, & Gallagher, J.S., (2007), *Galaxies in the Universe,* 2nd 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 TITLE	**Ultraviolet, Optical and Infrared Astronomy (UVOIR)**				
MODULE CODE	AA2053 (L5)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Anne Sansom				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**AA1051**	**Excluded Combinations**	**None**

MODULE AIMS

- 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.

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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT 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.

Assessments consist of one question sheet based on the theoretical material, and two reports based on the practical material.

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.

The 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.

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6

TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	Form of Assessment	% weighting	Size of Assessment/Duration/ Wordcount (indicative only)	Learning Outcomes being assessed
1	*Question Sheet (including problems and short summary question).*	*40%*	*3 problems plus 200 word summary*	*1,2,3,4*
1	*Case study report (instrumentation)*	*30%*	*8-10 pages*	*1,3,4*
1	*Data Analysis report based on imaging observations and their reduction.*	*30%*	10-12 pages	*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
E-learn server: 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* 5th 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

MODULE TITLE	**Exploring the Solar System**				
MODULE CODE	AA2054 (L5)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Barbara Hassall/Don Kurtz				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**AA1055 (or equivalent)**	**Excluded Combinations**	**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, 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.

MODULE 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.

LEARNING OUTCOMES

On successful completion of this module a student 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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

Distance learning students will learn via self-study, supported by detailed distance learning material supplied by the Course Team 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.

A *Study Guide* containing directed reading from recommended textbooks, internet resources. This is supported by tutorials and on-line discussions. 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.

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	Form of Assessment	% weighting	Size of Assessment/Duration/ Wordcount (indicative only)	Learning Outcomes being assessed
1	Question Sheet	40%	6 questions	1,2
1	Preparation of an IT presentation	20%	7-10 slides (equivalent to 10-15 minute presentation)	3,5
1	Researched essay	40%	2,500 words	3,4

MODULE PASS REQUIREMENTS

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 WebCT server: elearn.uclan.ac.uk
Study Guide includes bibliography and WWW start-points for researched essay.
Distance Learning Website: http://www.studyastronomy.com

Recommended Textbook:

Lang, K. R., (2011) *The Cambridge Guide to the Solar System*, 2nd edition, Cambridge University Press

Freedman , R.A., Geller R & Kaufman, W. J., (2010) *Universe* 9th ed., W. H. Freeman.

Further recommended reading:

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

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

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

Milone E. and W. J. F. Wilson, (2008) *Solar System Astrophysics*, Springer (e-book available via UCLan electronic resources.)

MODULE TITLE	**Solar Astrophysics**				
MODULE CODE	AA2055 (L5)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Robert Walsh/Silva Dalla				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**AA1051 or AA1058**	**Excluded Combinations**	**None**

MODULE AIMS

- 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 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.

MODULE 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

LEARNING OUTCOMES

On successful completion of this module a student 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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

Distance learning students will learn via self-study according to a Course Schedule, supported by detailed distance learning material supplied by the Department. Each student will have access to *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.

The experimental reports will be based on data sets provided on-line to the student 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 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.

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
2	*Question and problem sheets*	*2 x 25%*	*4-5 questions*	*1,2,3,4*
2	*Experimental report based on data analysis*	*2 x 25%*	*10-12 pages*	*4,5,6*

MODULE PASS REQUIREMENTS

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

BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL

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.

MODULE TITLE	**Solar-Stellar Connections**				
MODULE CODE	AA2056 (L5)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Gordon Bromage Don Kurtz				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**AA2055**	**Excluded Combinations**	**None**

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.

MODULE 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.

LEARNING OUTCOMES

On successful completion of this module a student 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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

Distance learning students will learn via self-study according to a Course Schedule, supported by detailed distance learning material supplied by the Course Team. Course Notes are supplied on-line, 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 can access 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.

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.

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

DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
2	*Question sheets and problems*	*20%, 25%*	*4 questions*	*1,2,3*
1	*Essay,*	*30%*	*1500 words*	*2,4,5*
1	*Timed assignment – open book test*	*25%*	*4-6 hours work within a 2.5 day specified window.*	*1,2,3*

MODULE PASS REQUIREMENTS

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.

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 9th edition is valuable.
Freedman , R.A., Geller R & Kaufman, W. J., (2010) *Universe* 9th ed., W. H. Freeman.

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 TITLE	**Astrobiology**				
MODULE CODE	AA2057 (L5)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Ian Butchart				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**AA1051 or equiv**	**Excluded Combinations**	**None**

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.

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

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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY Distance learning students will learn via self-study, supported by detailed distance learning material supplied by the Course Team according to a Course Schedule. Each student will have access to 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.	
DIRECT CONTACT HOURS	**No of hours**
Lectures	
Tutorial	6
Revision Class	
Examination	
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
First reading of posted materials (equiv to lectures)	48
Working through details in notes	70
Background Reading	40
Working on coursework assignments	30
Reflection on feedback	6
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
2	Question Sheets with Questions and problems		6 questions	1,2,3,5
1	Researched Essay		1500 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

Recommended text book

Rothery, David A., Gilmour, Iain and Sephton, Mark A, (2011) *An Introduction to Astrobiology 2nd Edition,* Cambridge University Press

Further reading

Jonathan Lunine, (2004) *Astrobiology: A Multi-Disciplinary Approach,* Publisher: Benjamin Cummings,
Andrew Shaw, (2006) *Astrochemistry: From Astronomy to Astrobiology,* Wiley,

On-line Magazine
Astrobiology Magazine http://www.astrobio.net/

MODULE TITLE	**Astronomy Dissertation**				
MODULE CODE	AA3050 (L6)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning – year-long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Tim Cawthorne / Barbara Hassall				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**None**	**Excluded Combinations**	**None**

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.

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 sufficienty focused to allow an indepth review of the topic and for the discussion to be at an advanced academic level.

LEARNING OUTCOMES

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

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

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

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.

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.

It is essential for students to have access to a PC with internet access.

DIRECT CONTACT HOURS	**No of hours**
On-line tutorial	6
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
Background Reading	150
Prep of dissertation	40
Reflection on feedback	4
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	Form of Assessment	% weighting	Size of Assessment/Duration/ Wordcount (indicative only)	Learning Outcomes being assessed
1	Work Plan (demonstrating planning and selection of topic	5%	Approx 2 pages	1,2
1	Dissertation	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

Library and internet resources.

Scientific refereed publications accessible via uclan's electronic resources.

MODULE TITLE	**Origins**				
MODULE CODE	AA3051 (L6)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance learning - year long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Victor Debattista, Barbara Hassall				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**None**	**Excluded Combinations**	**None**

MODULE AIMS

This Level 6 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.

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).

LEARNING OUTCOMES

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

1.	analyse the scientific motivation for current initiatives in astronomy research.
2.	analyse how scientific objectives drive the planning and development of major research

	programmes.
3.	prepare a critical literature review of a current research topic.
4.	critically assess information and concepts and draw conclusions from them.
5.	use IT resources at a high level to deliver a scientifically mature seminar.
6.	summarise and communicate scientific ideas.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

Distance learning students will learn via self-study according to a Module Schedule, supported by distance learning material supplied by the Course Team 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, the examination will be 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 with internet access.

DIRECT CONTACT HOURS	**No of hours**
On-line tutorial (DL students)	6
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
Reading lecture notes	48
Reviewing course notes	55
Exercise questions	30
Background Reading	25
Working on coursework assignments	32
Reflection on feedback	4
Revision for examinations	
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
1	Timed online assignment	30%	3 hours within 2.5 day specified window	1,2,4
1	Seminar Presentation	15%	20 mins (max 15 slides)	4,5,6
1	Critical/analytical essay	20%	2000 words	3,4,6
1	Portfolio of student seminars	35%	Write-ups of about 4 seminars	4,6

MODULE PASS REQUIREMENTS

It is not necessary to pass each item of assessment individually provided that all components have been attempted, the mark for the timed on-line assignment is at least 30% and the overall module mark is 40% or more.

BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL

WebCT server: elearn.uclan.ac.uk

Recommended textbook:
Library 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 TITLE	**Cosmology and Relativity**				
MODULE CODE	AA3053 (L6)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	On-campus– year long Distance learning – year long				
PATTERN OF DELIVERY	On-campus - Weekly lectures Distance Learning - Course schedule				
MODULE TUTOR	Roger Clowes/ Tim Cawthorne				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**(AA1053, AA1056) DL only**	**Excluded Combinations**	**None**

MODULE AIMS

To introduce a mathematical approach to Cosmology and Relativity.

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

For Distance Learning students. To build upon the *Introduction to Cosmology* provided by AA1053.

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_o, 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_o.
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.

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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

DISTANCE LEARNING

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

Student will have access to 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.

DIRECT CONTACT HOURS	**No of hours**
Online tutorial	6
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
Reading lecture notes	48
Reviewing course notes	55
Exercise questions	30
Background Reading	25
Working on coursework assignments	32
Reflection on feedback	4
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

LEARNING, TEACHING AND ASSESSMENT STRATEGY

ON CAMPUS

Delivery will be via lectures, problem sessions and classes discussions, directed reading and private study.

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.

DIRECT CONTACT HOURS	**No of hours**
Lectures	48
Tutorial	24
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	72
INDEPENDENT LEARNING HOURS	
Reading lecture notes	6
Reviewing course notes	31
Exercise questions	30
Background Reading	25
Working on coursework assignments	32
Reflection on feedback	4
TOTAL INDEPENDENT LEARNING HOURS	128
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	Form of Assessment	% weighting	Size of Assessment/Duration/ Wordcount (indicative only)	Learning Outcomes being assessed
2	Question Sheet (conceptual questions and mathematical problem-solving.)	2x35%	6 substantial questions	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

Ryden, B. (2002) *Introduction to Cosmology* Addison Wesley .

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

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,

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

Roos, M., (2003) *Introduction to Cosmology*, 3rd Edition Wiley.

MODULE TITLE	**Extreme States of Matter**				
MODULE CODE	AA3056 (L6)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning, Year-long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Ian Butchart /Barbara Hassall				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**AA1056 and AA1051**	**Excluded Combinations**	**None**

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.

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 quadrapole radiation, absorption and emission processes, forbidden lines. Examples of astrophysical spectra.

Gravitational Radiation: production of gravitational waves, quadrapole 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.

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.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT 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 spans 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.	
DIRECT CONTACT HOURS	**No of hours**
On-line tutorial	6
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	6
INDEPENDENT LEARNING HOURS	
Reading lecture notes	48
Reviewing course notes	55
Exercise questions	30
Background Reading	25
Working on coursework assignments	32
Reflection on feedback	4
Revision for examinations	
TOTAL INDEPENDENT LEARNING HOURS	194
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
3	Question Sheets (problems involving maths/physics application to Astrophysics)	3x25%	4-6 questions	1,2,3,4,5
1	Timed on-line test (open book)	25%	3-4 hours during a specified 2.5 day window.	1,2,3,4,5

MODULE PASS REQUIREMENTS

It is not necessary to pass each item of assessment individually provided that all components have been attempted, the mark for the timed on-line assignment is at least 30%, average of the three Question Sheets is at least 30% and the overall module mark is 40% or more.

BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL

No single book covers all topics in this module.

Further Reading:-

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

Malcolm S Longair, (1992) *High Energy Astrophysics: Particles, Photons and their Detection.* Vol 2 Cambridge University Press

Malcolm S Longair, (1994) *Stars, the Galaxy and the Interstellar Medium.* Vol 2, Cambridge University Press .

MODULE TITLE	**Collaborative Investigations**				
MODULE CODE	AA3057 (L6)	**CREDIT VALUE**	20 Credits		
MODULE DELIVERY	Distance Learning, Year-long				
PATTERN OF DELIVERY	DL course schedule				
MODULE TUTOR	Barbara Hassall/Anne Sansom				
DATE APPROVED	12 April 2011			**VERSION NUMBER**	1
SCHOOL	**CEPS**	**PARTNER INSTITUTION**		**N/A**	

RELATIONSHIP WITH OTHER MODULES

Co-requisites	None	**Pre-requisites**	**AA1057**	**Excluded Combinations**	**None**

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.

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.

LEARNING OUTCOMES

On successful completion of this module a student will be able to:	
1.	work as a team member towards common aims and objectives, meeting the teams' self imposed deadlines.
2.	collect and collate information that is relevant to the team project.
3.	exercise scientific judgement on material.
4.	make a significant (and integrated) contribution to a team presentation.
5.	make a significant independent and integrated contribution to the common report.

MODULE LEARNING PLAN

LEARNING, TEACHING AND ASSESSMENT STRATEGY

Distance learning students will learn via self-study according to a Module Schedule, supported by distance learning material supplied by the Course Team 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:

- regular 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).

DIRECT CONTACT HOURS	**No of hours**
On-line tutorial	9
TOTAL CONTACT HOURS **(At Level 4, normally a minimum of 60 hours per 20 credits, unless offset elsewhere in the course)**	9
INDEPENDENT LEARNING HOURS	
Background Reading	100
Discussions with fellow students	40
Reflection on feedback	6
Preparation of the report	35
Preparation of the presentation	10
TOTAL INDEPENDENT LEARNING HOURS	191
TOTAL STUDENT LEARNING HOURS ***These must add up to 200 hours per 20 credits***	200

INDICATIVE ASSESSMENT

Number of Assessments	**Form of Assessment**	**% weighting**	**Size of Assessment/Duration/ Wordcount** (indicative only)	**Learning Outcomes being assessed**
1	Work done and contribution to the group effort. (Assessed by peer group)	30%	Not applicable.	1,2,4,5
1	Final Report	40%	10-15 pages per student,	2,3,5
1	On-line Presentation	30%	Equivalent to about 8 minutes per student.	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 is 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 electronic resources and journals.
University's study skills website.