# MODULE DESCRIPTOR

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|---|---|---|---|---|---|
| **MODULE TITLE** | **Cosmology and Relativity** | | | | |
| **MODULE CODE** | AA3053 (L6) | **JACS CODE** | **F500** | **CREDIT VALUE** | *20* |
| **DATE OF APPROVAL** | April 2017 | | | **VERSION NUMBER** | 1 |
| **SCHOOL** | **Physical Sciences and Computing** | | **PARTNER INSTITUTION** | | |

## RELATIONSHIP WITH OTHER MODULES

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

## MODULE AIMS

This module aims to:

- Introduce a mathematical approach to Cosmology and Relativity.
- Present the essentials of cosmology and relativity, emphasising the underlying physics and the observational consequences.
- To build upon previous study of introductory cosmology.

## 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.

## INTENDED LEARNING OUTCOMES

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

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|---|---|
| **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. |

## ASSESSMENT METHODS

The method of assessment for this module has been designed to test all the learning outcomes. Students must demonstrate successful achievement of these learning outcomes to pass the module.

| **Number of Assessments** | **Form of Assessment** | **% weighting** | **Size of Assessment/Duration/ Wordcount** | **Category of assessment** | **Learning Outcomes being assessed** |
|---|---|---|---|---|---|
| 2 | Question Sheet (conceptual questions and mathematical problem-solving.) | 2x35% | 3-4 substantial questions | Coursework | 1,2,3,4 |
| 1 | Critical review | 30% | 1500 words | Coursework | 4,5 |

## MODULE PASS REQUIREMENTS

To pass this module you must achieve a mark of 40% or above, aggregated across all the assessments.

**APPENDIX**

**MODULE CODE: AA3053 MODULE TITLE: Cosmology and Relativity**

**LOCATION OF STUDY:** *UCLAN CAMPUS*

| | |
|---|---|
| **MODULE TUTOR(S)** | *Roger Clowes/ Tim Cawthorne* |

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|---|---|---|---|---|---|---|---|---|
| **MODULE DELIVERY** | Semester Long | Semester 1 | | Semester 2 | | Semester 3 | | |
| | Year long | Semester 1 & 2 | ✓ | Semester 2 & 3 | | | | |
| | Other (please indicate pattern of delivery) | DISTANCE LEARNING | | | | | | |

## MODULE LEARNING PLAN

*All modules should include details of the average learning time based upon 200 hours per 20 credits.*

**LEARNING, TEACHING AND ASSESSMENT STRATEGY**
**DISTANCE LEARNING**

**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 via online discussion forums, online classrooms email and telephone as required. Students will be encouraged to participate in on-line class discussions.

The learning materials include Course Notes with worked examples, self-test exercises and assessed coursework. Additional material and suggested further reading are available via Blackboard. The approach is quantitative and more mathematical than previous cosmology modules. Self test exercises contain questions to encourage students to solve conceptual and numerical problems and to build their confidence prior to attempting the assessed question sheets.

- The assessed question sheets are designed to enable students to demonstrate their understanding and ability to solve problems and explain the concepts involved.
- The critical review will be prefaced by guidance on researching and writing a scientific essay. It will enable students to critically assess ideas and results, draw conclusions and communicate complex ideas in a scientifically mature manner.

| **SCHEDULED LEARNING AND TEACHING ACTIVITY** | **No of hours** |
|---|---|
| Online tutorial | |
| **TOTAL SCHEDULED LEARNING HOURS** | 6 |
| **GUIDED INDEPENDENT STUDY**<br>Reading lecture notes<br>Reviewing course notes<br>Exercise questions<br>Background Reading<br>Working on coursework assignments<br>Reflection on feedback | |
| **TOTAL GUIDED INDEPENDENT STUDY HOURS** | 194 |
| ***TOTAL STUDENT LEARNING HOURS***<br>***These must add up to 200 hours per 20 credits*** | 200 |

## BIBLIOGRAPHY AND LEARNING SUPPORT MATERIAL

On-line Booklist: http://readinglists.central-lancashire.ac.uk/search.html?q=AA3053