1. **Title of the module**

PHYS6070 (PH607) - The Physics of Stars and Cosmology

1. **School or partner institution which will be responsible for management of the module**

Physical Sciences

1. **The level of the module (Level 4, Level 5, Level 6 or Level 7)**

Level 6

1. **The number of credits and the ECTS value which the module represents**

15 credits (7.5 ECTS)

1. **Which term(s) the module is to be taught in (or other teaching pattern)**

Spring

1. **Prerequisite and co-requisite modules**

None

1. **The programmes of study to which the module contributes**

BSc/ BSc with Year in Industry/MPhys & MPhys with Year Abroad in Physics with Astrophysics

BSc/ BSc with Year in Industry/MPhys & MPhys with Year Abroad in Astronomy Space Science and Astrophysics

This is not available as a wild module.

1. **The intended subject specific learning outcomes.
On successfully completing the module students will be able to:**
2. Demonstrate knowledge and understanding of physical laws and principles of astrophysics, and their application to diverse areas of physics.
3. Identify relevant principles and laws when dealing with problems, and to make approximations necessary to obtain solutions.
4. Solve problems in physics involving stars and galaxies using appropriate mathematical tools.
5. Use mathematical techniques and analysis to model physical behaviour of stars and galaxies and the universe.
6. Present and interpret information about stars and galaxies graphically.
7. Make use of appropriate texts, research-based materials or other learning resources about astrophysics as part of managing their own learning.
8. **The intended generic learning outcomes.
On successfully completing the module students will be able to:**
9. Solve problems, in the context of both problems with well-defined solutions and open-ended problems. Numeracy is subsumed within this area.
10. Use analytical skills – associated with the need to pay attention to detail and to develop an ability to manipulate precise and intricate ideas, to construct logical arguments and to use technical language correctly.
11. **A synopsis of the curriculum**

Aims:To provide, in combination with PH507, a balanced and rigorous course in Astrophysics for B.Sc. Physics with Astrophysics students, while forming a basis of the more extensive M.Phys modules.

Physics of Stars

equations of state for an ideal multiple chemical component star; degenerated stars, Nuclear reactions: PPI, PPII, PPIII chains; CNO cycle, Triple-alpha process; elemental abundances; energy transportation inside a star; derivation of the approximate opacity and energy generation models as function of density, temperature and chemical components; Solar neutrino problem; polytropic models applied to the equations of stars; Lane-Emden equation; Chandrasekhar mass; the Eddington Luminosity and the upper limit of mass; detailed stellar models; Post main sequence evolution of solar mass stars; Red Giants; White Dwarfs; Neutron Stars; Degenerate matter; properties of white dwarfs; Chandrasekhar limit; neutron stars; pulsars; Supernovae

General Relativity and Cosmology

Inadequacy of Newton's Laws of Gravitation, principle of Equivalence, non-Euclidian geometry. Curved surfaces. Schwarzschild solution; Gravitational redshift, the bending of light and gravitational lenses; Einstein Rings, black holes, gravitational waves; Brief survey of the universe; Olbers paradox, Cosmology, principles, FRW Metric, Laws of Motion & Distances, Friedmann equation, Scale Factor, Fluid equation, The Hubble Parameter, Critical Density parameter, Cosmological Constant parameter, Radiation-Matter-Dark Energy phases; The CMB, Temperature Horizons. Monopoles. Flatness problem. Hubble sphere, Inflation, Anisotropies, Polarisation Baryon Acoustic Oscillations, Secondary anisotropies; Baryosynthesis, Nucleosynthesis, Dark Matter observations, Lensing, Bullet Cluster, Dark Matter candidates, Cosmic Distance Ladder, Redshifts Galaxy surveys; Acceleration equation, Deceleration equation, Supernova as standard candles, Dark Energy, Einstein Field equations, Coincidence problem, The Cosmic Dark Ages & AGN Reionisation, High-z galaxies

1. **Reading list (Indicative list, current at time of publication. Reading lists will be published annually)**
* Carroll & Ostlie, Modern Astrophysics, Addison Wesley, 2013
* Bohm-Vitense, Volume 3; Stellar Structure and Evolution, Cambridge University Press, 1992
* Taylor, The stars: Their structure and Evolution, Cambridge University Press, 2010
* Berry, Principles of Cosmology and Gravitation, Adam Hilger, 1989
* Roos, Introduction to Cosmology, Wiley, 2015
* Peacock, Cosmological Physics, Cambridge University Press, (1999)
* Rowan-Robinson, Cosmology, OUP, 2004
1. **Learning and teaching methods**

Total contact hours: 30

Private study hours: 120

Total study hours: 150

1. **Assessment methods**
	1. Main assessment methods

Test 1 (3 hours,15%)

Test 2 (3 hours,15%)

Examination (2 hours, 70%)

13.2 Reassessment methods

Like-for-like

1. **Map of module learning outcomes (sections 8 & 9) to learning and teaching methods (section12) and methods of assessment (section 13)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module learning outcome** | *8.1* | *8.2* | *8.3* | *8.4* | *8.5* | *8.6* | *9.1* | *9.2* |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |
| Private Study | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |
| *Lectures* | **x** | **x** | **x** | **x** | **x** |  | **x** | **x** |
| **Assessment method** |  |  |  |  |  |  |  |  |
| *Tests* | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |
|  *Examination* | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |

1. **Inclusive module design**

The School recognises and has embedded the expectations of current equality legislation, by ensuring that the module is as accessible as possible by design. Additional alternative arrangements for students with Inclusive Learning Plans (ILPs)/declared disabilities will be made on an individual basis, in consultation with the relevant policies and support services.

The inclusive practices in the guidance (see Annex B Appendix A) have been considered in order to support all students in the following areas:

a) Accessible resources and curriculum

b) Learning, teaching and assessment methods

1. **Campus(es) or centre(s) where module will be delivered**

Canterbury

1. **Internationalisation**

This is an international subject with physical laws discovered and techniques developed and refined by scientists across the globe. Mastery of the subject-specific learning outcomes will equip students to apply the theories and techniques of this module in a wide range of international contexts. The module team is drawn from the School of Physical Sciences, which includes many members of staff with international experience of teaching and research collaboration. In compiling the reading list, consideration has been given to the range of texts that are available internationally and a selection of texts has been identified to complement the delivery of the material. The support SPS provides to its students is also internationally attuned given our international student body.

**FACULTIES SUPPORT OFFICE USE ONLY**

**Revision record – all revisions must be recorded in the grid and full details of the change retained in the appropriate committee records.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date approved | Major/minor revision | Start date of the delivery of revised version | Section revised | Impacts PLOs (Q6&7 cover sheet) |
| 27/02/19 | Major | January 2021 | 1,7,8,9,10,11,12 | no |
|  |  |  |  |  |

Revised FSO Jan 2018