1. **Title of the module**

PHYS7110 (PH711) - Rocketry and Human Spaceflight

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 7

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**

Prerequisite:

PHYS5080 Spacecraft Design and Operations

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

MPhys/MPhys with Year Abroad Physics

MPhys/MPhys with Year Abroad Physics with Astrophysics

MPhys/MPhys with Year Abroad Astronomy Space Science and Astrophysics

MSc Physics Euromasters

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:**

Have a knowledge and understanding of:

1. Aspects of the theory and practice of space science, and of those aspects upon which space science depends in relation to rocketry and Human Space Flight (a knowledge of key physics, especially for rocketry). (A2)
2. An understanding of relevant fundamental laws and principles of physics, along with their application to rocketry and human spaceflight. (A3)
3. An ability to identify relevant principles and laws when dealing with problems, and to make approximations necessary to obtain solutions. (B1)
4. An ability to solve problems in rocketry and human spaceflight using appropriate mathematical tools. (B2)
5. An ability to use mathematical techniques and analysis to model physical behaviour. (B4)
6. An ability to solve advanced problems in rocketry and human spaceflight using appropriate mathematical tools, to translate problems into mathematical statements and apply their knowledge to obtain order of magnitude or more precise solutions as appropriate. (B6)
7. An ability to interpret mathematical descriptions of physical phenomena. (B7)
8. An ability to present and interpret information graphically. (C2)
9. An ability to make use of appropriate texts, research-based materials, other primary sources or other learning resources as part of managing their own learning. (C6, 10)

Other more specific learning outcomes:

1. To develop an appreciation of the design, construction and testing of space vehicles and their operation.
2. To understand the basic physiological changes the human body is subject to in space.
3. To develop an appreciation of the uses of space for science and by astronauts.
4. **The intended generic learning outcomes.  
   On successfully completing the module students will be able to:**

Have a knowledge and understanding of:

1. Problem-solving skills, in the context of both problems with well-defined solutions and open-ended problems; an ability to formulate problems in precise terms and to identify key issues, and the confidence to try different approaches in order to make progress on challenging problems. Numeracy is subsumed within this area. (D1)
2. Investigative skills in the context of independent investigation including the use of textbooks and other available literature and databases to extract important information. (D2)
3. Communication skills in the area of dealing with surprising ideas and difficult concepts, including listening carefully, reading demanding texts. (D3 partial)
4. 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. (D4)
5. **A synopsis of the curriculum**

Flight Operations: Control of spacecraft from the ground, including aspects of telecommunications theory.

Propulsion and attitude control: Physics of combustion in rockets, review of classical mechanics of rotation and its application to spacecraft attitude determination and control.

Impact Damage: The mechanisms by which space vehicles are damaged by high speed impact will be discussed along with protection strategies.

Human spaceflight: A review of human spaceflight programs (past and present). Life-support systems. An introduction to some major topics in space medicine; acceleration, pressurisation, radiation, etc.

International Space Station: Status of this project/mission will be covered.

1. **Reading list (Indicative list, current at time of publication. Reading lists will be published annually)**

Recommended Text:

* Fortescue, Stark and Swinerd, Spacecraft Systems Engineering, 3rd ed, Wiley, 2003 [TL875, 6 copies]
* Wertz and Larson, Space Mission Analysis and Design, 3rd Edition, 1999 [TL 790]
* Sutton, Rocket Propulsion Elements, 1992 [TL 782]
* Sidi, Spacecraft Dynamics and Control, 1997 [TL 1050]

Background reading (In addition, a fuller reading list will be distributed in the lectures):

* McNamara: Into the Final frontier, Harcourt, 2000 [qTL873]
* Nicogossian, Huntoon and Pool: Space Physiology and Medicine, Lea & Febiger, 1994 [RC1150]
* Turner: Rocket and Spacecraft Propulsion, Praxis, 2000 [TL782]

1. **Learning and teaching methods**

Total contact hours (Lectures and workshop sessions – does not include office contact hours): 30

Private study hours: 120

Total study hours: 150

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

Two homework assignments (15% each, 10 hours each)

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 | 8.7 | 8.8 | 8.9 | 8.10 | 8.11 | 8.12 | 9.1 | 9.2 | 9.3 | 9.4 |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lectures and workshops | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |  | **x** | **x** | **x** | **x** |  | **x** | **x** |
| Private study | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **X** |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Assignments | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |
| Examination | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |

1. **Inclusive module design**

The School/Collaborative Partner *(delete as applicable)* 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**

Rocketry and Human Spaceflight is an international subject with physical laws discovered and techniques developed and refined by scientists and engineers across the globe (the associated texts were drawn from this international expertise and knowledge base). Mastery of the subject-specific learning outcomes will equip students to apply the theories and techniques of this module to related problems. The module team is drawn from the School of Physical Sciences, which includes members of staff with experience of international collaborations in space sciences. 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 delivery of revised version | Section revised | Impacts PLOs (Q6&7 cover sheet) |
| 10/07/2019 | Minor | January 2020 | 13 |  |
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