Confirmation that this version of the module specification has been approved by the School Learning and Teaching Committee:

………19th June 2015………………………………………….

**MODULE SPECIFICATION**

1. **Title of the module**

PH611 Numerical and Computational Methods

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

School of Physical Sciences

1. **Start date of the module**

Revision of existing module, next running 2015-16

1. **The number of students expected to take the module**

80 students

1. **Modules to be withdrawn on the introduction of this proposed module and consultation with other relevant Schools and Faculties regarding the withdrawal**

None

1. **The level of the module (e.g. Level 4, Level 5, Level 6 or Postgraduate 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**

Spring

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

PH300, PH302

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

BSc, MPhys and MPhys with Year in the USA; Physics, and 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 have:

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| **A. Knowledge and understanding of:** |
| 11.1 physical laws and principles, and their application to diverse areas of physics |
| **B. Intellectual skills:** |
| 11.2 An ability to identify relevant principles and laws when dealing with problems, and to make approximations necessary to obtain solutions. |
| 11.3 An ability to solve problems in physics using appropriate mathematical tools. |
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| 11.4 An ability to use mathematical techniques and analysis to model physical behaviour. |
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| 11.5 an ability to solve advanced problems in physics 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. |
| 11.6 an ability to interpret mathematical descriptions of physical phenomena. |
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| 11.7 a working knowledge of a variety of mathematical and/or computational techniques applicable to current research within physics. |
| **C. Subject-specific skills:** |
| 11.8 Competent use of appropriate C&IT packages/systems for the analysis of data and the retrieval of appropriate information. |
| 11.9 An ability to present and interpret information graphically. |
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| 11.10 An ability to make use of appropriate texts, or other learning resources as part of managing their own learning. |

Relationship to programme learning outcomes is direct, as per labelling above (B2, C2, C6) in programme specification.

1. **The intended generic learning outcomes**

On successfully completing the module level students will have:

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| **D. Transferable skills:** |
| 12.1 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. |
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| 12.2 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. |

Relationship to programme learning outcomes is direct, as per labelling above (D4) in programme specification.

1. **A synopsis of the curriculum**

In Stage 1 and Stage 2, students frequently apply analytical methods to physical problem solving. This module provides a foundation in numerical approximations to analytical methods – these techniques are essential for solving problems by computer. The following topics are covered: Linear equations, zeros and roots, least squares & linear regression, eigenvalues and eigenvectors, errors and finite differences, linear programming, interpolation and plotting functions, numerical integration, , numerical differentiation, solutions to ordinary differential equations using numerical methods.

1. **Indicative Reading List**

S. Chapra, *Applied Numerical Methods with MATLAB for Engineers and Scientists*, McGraw-Hill, 2008. ISBN: 978-0-07-313290-7 (CORE TEXT)

C. Moler*, Numerical Computing with MATLAB, Society for Industrial and Applied Mathematics*, SIAM, 2004 [ISBN 978-0-898715-60-6](http://en.wikipedia.org/wiki/Special:BookSources/9780898715606) (ADDITIONAL READING)

1. **Learning and Teaching Methods, including the nature and number of contact hours and the total study hours which will be expected of students, and how these relate to achievement of the intended module learning outcomes**

Contact hours: 20 hours of lectures, 12 computer console sessions, total study hours: 150

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| **A. Knowledge and understanding of: (11.1)** |
| *Learning & Teaching*: lectures given by a variety of teachers and supported by examples/computer console sessions; personal study using textbooks, web-based material and other self-study material. |
| **B. Intellectual skills: (11.2-11.7)** |
| *Learning & Teaching*: lectures (gathering and ordering information), problem sheets (problem solving) and computer console sessions (recognise and analyse problems, implement computer code). |
| **C. Subject-specific skills: (11.8-11.10)** |
| *Learning & Teaching*: Solving numerical problems by computer; personal study using textbooks, web-based material and other self-study material. |
| **D. Transferable skills: (12.1, 12.2)** |
| *Learning & Teaching*: problem solving and computer programming; personal study using textbooks, web-based material and other self-study material. |

1. **Assessment methods and how these relate to testing achievement of the intended module learning outcomes**

40% coursework: 6 problem sheets involving handwritten and computer programming components; 60% final exam (length 2 hours)

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| **A. Knowledge and understanding of: (11.1)** |
| *Assessment*: coursework involving problems, console work and writtenexaminations. |
| **B. Intellectual skills: (11.2-11.7)** |
| *Assessment*: coursework involving problems, console work and written examinations. |
| **C. Subject-specific skills: (11.8-11.10)** |
| *Assessment*: coursework involving problems, console work. |
| **D. Transferable skills: (12.1, 12.2)** |
| *Assessment*: coursework involving problems, console work. |

1. **Implications for learning resources, including staff, library, IT and space**

None

1. **The School recognises and has embedded the expectations of current disability equality legislation, and supports students with a declared disability or special educational need in its teaching. Within this module we will make reasonable adjustments wherever necessary, including additional or substitute materials, teaching modes or assessment methods for students who have declared and discussed their learning support needs. Arrangements for students with declared disabilities will be made on an individual basis, in consultation with the University’s disability/dyslexia support service, and specialist support will be provided where needed.**
2. **Campus(es) or Centre(s) where module will be delivered:**

Canterbury