Computational Physics

Module Code	PHYS96010	FHEQ Level	Level 6
Pre-requisites	None	Co-requisites	None
Primary Department	Physics		
Module Leader	Professor Paul Dauncey and Dr Mark Scott		
Additional Teaching Departments	None		
Teaching Staff	Professor Paul Dauncey + Dr Mark Scott + Associate + Demonstrators		
Programmes on which the Module is delivered			Core/Elective
All UG Physics programmes (F300, F303, F309, F325, F390, F3W3)			Elective
Learning Outcomes	On completing the Computational Physics course, students will be able to: ● Identify fundamental problem types in computational physics (root-finding, interpolation, matrix inversion, optimisation, integration, differential equations) ● Select and implement bisection for root-finding, cubic splines for interpolation, and assorted basic methods for solving matrix equations. ● Select suitable random number generators and use them in 'Monte Carlo' methods for multi-dimensional function minimisation and integration. ● Select, assess (in terms of accuracy, stability & efficiency) and implement finite difference methods to perform numerical integration and solve differential equations in physics. ● Design and write computer programs to solve physics problems using any of the above techniques. ● Use numerical library routines as glass boxes rather than black boxes.		
Description of Content	● IEEE variable types and floating-point arithmetic ● Root-finding ● Basic matrix inversion methods ● Interpolation ● Random numbers: How to generate non-uniform random distributions. Using them to efficiently calculate multi-dimensional integrals.		

	● Optimisation problems: Newton and Monte Carlo methods for finding the minimum of general multi-dimensional functions. ● Fourier transform methods ● Analysis of the accuracy and stability of numerical methods for solving differential equations. ● Numerical integration via finite difference methods. ● Solution of initial value ODE problems (Runge Kutta and related finite difference methods) ● Solution of boundary value ODEs (shooting and related methods) ● Solution of initial-value parabolic and hyperbolic PDEs using finite difference methods. ● Use of matrix methods to solve elliptic (boundary-value) differential equations. ● Hands-on application of numerical methods (i.e. the topics above) to solving problems in physics.

Assessment		Assessment Type	Weighting
Written exam		Exam	40%
Projects		Coursework	60%
Learning & Teaching Hours	Independent Study Hours	Placement Hours	Total Hours
58	92	0	150
ECTS Credit	6	CATS Credit	12
Date of introduction	October 2016	Date of Last Revision	23/04/2020