PH3080 - Computational Physics

Credits:	10.0	**Semester:**	Semester one and the start of semester two
Number of Lectures:			
Available:	All	**Lecturer:**	Dr Michael Mazilu and Dr Aly Gillies

Overview

This module is designed to develop a level of competence in Mathematica, a modern programming language currently used in many physics research labs for mathematical modelling. No prior experience is required. The module starts with a grounding in the use of Mathematica and discusses symbolic solutions and numerical methods. The main focus will be the use of Mathematica for problem solving in physics. The module is continually assessed through short tests and assignments, with the bulk of the assessment based on the submission of a Mathematica project.

Aims & Objectives

1. To develop a level of expertise in Mathematica and to introduce various common techniques used to solve and visualise physical problems; this includes both 2-D and 3-D graphical output and movies for visualising physics problems.
2. Data analysis to extract physical information from measured data and images.
3. Solution of first and second order differential equations.
4. Use of compile to speed up computationally intensive procedures.
5. Introduction to symbolic programming.
6. To introduce various numerical methods.

Learning Outcomes

The students will be able to program in Mathematica and be able to use Mathematica to solve, visualise and gain insight into a variety of physical problems. They should also be aware of the advanced capabilities of Mathematica including symbolical and numerical equation solving.

Synopsis

There are introductory programming labs teaching basic programming skills in Mathematica, different numerical methods and setting up physical problems. There are 4 case study labs and 1 homework case study. These are designed to provide case studies illustrating the use of Mathematica to solve and visualise a variety of Physics problems as well as introducing a number of advanced features in Mathematica. The case studies can vary from year to year but past case studies have included: Solving differential equations, Fourier transforms for image processing, Chaos and the Mandelbrot Set, Mechanics and motion of coupled bodies moving in a potential, Analysis of periodic structures and Matrix and Tensor manipulation. The final four weeks in the first semester is reserved for project work. There are 4-6 (supervised) lab sessions for project work where lecturers and demonstrators will be available for consultation. The first semester ends with a project milestone submission. The final project is submitted in the first weeks of the second semester.

Indicative timetable: S1 weeks 1-2: introduction, S1 weeks 3-7: case studies, S1 week 8: class test, S1 weeks 8-11: project, S2 weeks 1-4 project, S2 somewhere during weeks 4-7 each student has a 20 minute viva.

Indicative deadlines: S1 week 6: homework case study, week 11: project milestone submission, S2 week 4: final project submission.

Prerequisites

There are no prerequisites and no previous knowledge of computing is required.

Antirequisites
PH4030

Assessment

Continuous Assessment = 100% (1 class test 30%, 1 homework case study 20%, Computational Physics Project 50%)

Additional information on continuous assessment etc
Please note that the definitive comments on continuous assessment will be communicated within the module. This section is intended to give an indication of the likely breakdown and timing of the continuous assessment.

This module is worth 10 credits, with most of the work being spread over the 11 weeks of classes in semester one and three weeks of project work in semester two. That leads to the average student at this level being expected to invest about seven hours a week in this module during the time when it is running.

Recommended Books

Please view University online record:

http://resourcelists.st-andrews.ac.uk/modules/ph3080.html

General Information

Please also read the general information in the School's honours handbook.