

### Computational Science Senior units of study

For a major in Computational Science the minimum requirement is 24 credit points chosen from the core or elective Senior units of study listed for this subject area, of which at least 12 credit points must be from the following core Senior units of study:

COSC 3011 Scientific Computing  
 COSC 3911 Scientific Computing (Advanced)  
 COSC 3012 Parallel Computing & Visualisation  
 COSC 3912 Parallel Computing & Visualisation (Adv)  
 MATH 3076 Mathematical Computing \*  
 MATH 3976 Mathematical Computing (Advanced)\*  
 \*Refer to Mathematics listing in chapter 3 for descriptions of these units of study.

Senior elective units of study for a major in Computational Science are listed in Table I in chapter 3.

#### COSC 3011 Scientific Computing

6 credit points. B A, B E, B Sc, B Sc (Bioinformatics), UG Study Abroad Program. Dr Nigel Marks. **Session:** Semester 1. **Classes:** 2hr lec. & 3hr prac/wk. **Assumed Knowledge:** Programming experience in MATLAB. **Prerequisites:** 12 credit points chosen from Junior Mathematics and Statistics, 12 credit points of Intermediate units in Science subject areas. **Prohibitions:** COSC3911, COSC 3001, COSC 3901, PHYS3301, PHYS3901. **Assessment:** Lab, written exam.

This unit of study provides a senior-level treatment of scientific problem solving using computers. Students will understand and apply a wide range of numerical schemes for solving ordinary and partial differential equations. Linear algebra is used to provide detailed insight into stability analysis, relaxation methods, and implicit integration. A variety of scientific problems are considered, including planetary motion, population demographics, neutron criticality, traffic flow and quantum mechanics. All coding is performed with MATLAB, and basic programming experience is assumed.

##### Textbooks

Numerical Methods for Physics, 2nd Edition, by A.L. Garcia.

#### COSC 3911 Scientific Computing (Advanced)

6 credit points. B A, B E, B Sc, B Sc (Bioinformatics), UG Study Abroad Program. Dr Nigel Marks. **Session:** Semester 1. **Classes:** 2hr lec. & 3hr prac/wk. **Assumed Knowledge:** Programming experience in MATLAB. **Prerequisites:** 12 credit points chosen from Junior Mathematics and Statistics, 12 credit points of Intermediate units in Science subject areas with a credit average. **Prohibitions:** COSC3011, COSC 3001, COSC 3901, PHYS3301, PHYS3901. **Assessment:** Lab, written exam.

This unit is the Advanced version of COSC3011. The subject matter is very similar, but more challenging problems will be covered.

##### Textbooks

Numerical Methods for Physics, 2nd Edition, by A.L. Garcia.

#### COSC 3012 Parallel Computing & Visualisation

6 credit points. B A, B E, B Sc, B Sc (Bioinformatics), UG Study Abroad Program. Dr Nigel Marks. **Session:** Semester 2. **Classes:** 2hr lec & 3hr prac/wk. **Assumed Knowledge:** Programming experience in C and MATLAB or equivalent. **Prerequisites:** 12 credit points chosen from Junior Mathematics and Statistics, 12 credit points of Intermediate units in Science subject areas. **Prohibitions:** COSC3912, COSC 3002, COSC 3902, COSC3601, PHYS3303, PHYS3933. **Assessment:** Lab, practical exam.

The first half of the course considers Parallel Computing on distributed and shared memory architectures. Students learn the concepts of distributed-memory programming using the Message Passing Interface (MPI), while shared-memory programming is presented using OpenMP. Concepts covered include scalability, communication overheads, deadlocks,

domain decomposition and incremental parallelism. Basic programming ability in Fortran or C (or equivalent) is assumed. The second half of this course considers Scientific Visualisation as a tool for analysing, interpreting and communicating multi-dimensional numerical data. Students learn the principles and practice of Scientific Visualisation in the context of OpenDX, the open-source Data Explorer package developed by IBM. No previous experience is required, and the object-oriented visual programming environment is taught in the laboratory sessions.

#### COSC 3912 Parallel Computing & Visualisation (Adv)

6 credit points. B A, B E, B Sc, B Sc (Bioinformatics), UG Study Abroad Program. Dr Nigel Marks. **Session:** Semester 2. **Classes:** 2hr lec & 3hr prac/wk. **Assumed Knowledge:** Programming experience in C and MATLAB or equivalent. **Prerequisites:** 12 credit points chosen from Junior Mathematics and Statistics, 12 credit points of Intermediate units in Science subject areas with a credit average. **Prohibitions:** COSC3012, COSC 3002, COSC 3902, COSC3601, PHYS3303, PHYS3933. **Assessment:** Lab, practical exam. This unit is the advanced version of COSC3012. The subject matter is very similar, but more challenging problems will be covered.