12998-244(16) Computational Physics B (3l, 3p)
(Stochastic Simulation and Data Analysis)

2018

Course summary:

Numerical stimulation of many-particle and higher dimensional systems. Topics change annually. Typically they may include stochastic growth, lattice gases, sand-pile models or percolation. Introduction to statistical data analysis.

Method of assessment: Flexible assessment

Prerequisite pass modules: Physics 114, 144

Prerequisite modules: Physics 214, 224

Co-requisite modules:

- *Physics 254*
- *Scientific Computing 272*

Language policy:

Afrikaans and English in the same class groups:
During each lecture, all information is conveyed at least in English. Summaries and/or explanation of the core concepts will also be given in Afrikaans. Questions in Afrikaans and English will, at the least be answered in the language of the question. Students will be supported in Afrikaans and English during a combination of appropriate facilitated learning opportunities.

Module relevance in programme:

As physics systems become more complex with large numbers of particles and higher dimensions, numerical simulation of such systems becomes an important approach. Simultaneously one needs to develop a suitable statistical language and numerical toolset. Through investigating physical systems, we shall learn the basic elements needed for this approach. The module complements the first computational physics module (Physics 214), uses physics from second-year mechanics, and prepares some of the thinking necessary for the module in statistical physics (Physics 314). It is only required for students following the theoretical physics stream, but provides a useful set of tools for physics in general. The introduction of python in this module is very helpful in all later modules and connects well to Scientific Computing 272.

Outcomes of course:

Insight into the physics of selected simple stochastic physical systems.

- Working knowledge of basic concepts of statistics as used in physics.
- Appreciation of the fundamentally different character of computational physics as compared to analytical physics.
- The ability to write and debug simple computer simulations of stochastic physical systems.
- Appreciation of the importance and role played by numerical error and approximation in simulation.
- Develop skills in compiling and maintaining a record of own work and thoughts.
- Familiarity on beginner's level with the operating system currently used in the module and some of its numerical and graphical applications.

Lecturers:

Prof. HC Eggers
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Mentor:

The Department of Physics has appointed a staff member as mentor for each year of its physics programme to be available to students for consultation. Students should feel free to discuss general issues related to the physics programme or specific modules in the programme with the relevant mentor, in addition to usual consultations with their individual lecturers of modules.

The mentor for the second year programme and its modules is Dr PH Neethling pietern@sun.ac.za

Course content:

The course introduces numerical and mathematical methods of simulating and analysing stochastic physical systems and real data. The project-based topic changes annually; typical examples include data analysis, random walks, stochastic growth phenomena etc..Elementary programming skills are a prerequisite.

Laboratory work

Practical (Tutorials):

Students work individually or in groups on their tutorial assignments and projects during the tutorial session under supervision of the lecturer or a tutor.

Study material:

Due to the nature of this module there is no single prescribed text book. Study notes and reference material will be handed out by the lecturer.

Learning opportunities:

The individual work on simulation projects constitutes an effective learning opportunity. Every lecture and tutorial is an opportunity to discuss the project work with the lecturer and fellow students.

Assessment:

Methods of Assessments
Continuous assessment, based mainly on workbooks containing the student's notes, results and computer programs but also a test and possibly theory homework problems.

Venue and time of assessment opportunities
A number of assessment opportunities are spread evenly throughout the semester.

Turnaround time*:*
Marks will be available within a reasonable time. Feedback is given in terms of written and oral commentary

Availability of marks:
Papers are returned as soon as possible.

Calculation of final mark for the module:
Mark allocation may change depending on the nature of a given year's project. Typical weights would be

0-20 percent: homework problems
20-40 percent: test
60-80 percent: workbooks with project notes, results, computer programs