12998-244(16) Computational Physics B (3l, 3p)
(Deterministic Simulation)

2015

Course summary:

Computer-based projects for deterministic physical systems. Topics change annually. Typical examples are the chaotic pendulum, planetary motion, differential equations in quantum mechanics, integral equations for electromagnetic fields and waves.

Continuous assessment
PP Physics 114, 144
P Physics 214, 224
C Physics 254
C Scientific Computing 272

Outcomes of course:

- Insight into the physics of selected simple deterministic physical systems.
- Hands-on knowledge of selected concepts of physics (depending on the topic chosen in a given year) and their numerical implementation on the computer.
- Appreciation of the fundamentally different character of computational physics as compared to analytical physics.
- The ability to write and debug simple computer simulations of physical systems obeying differential equations.
- Appreciation of the importance and role played by numerical error and approximation in simulation.
- Developed skills in compiling and maintaining a record of own work and thoughts.
- Familiarity on intermediate level with the operating system currently used in the module and some of its numerical and graphical applications.
- Collaboration with other team members to plan and solve complex problems in a group.
- Exposure to new and exciting research fields in physics, and the finding resources to assist in research topics.
- Development of presentation skills, problem solving strategies and time management.

Lecturers:

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Course content:

Projects on deterministic physical systems using computer simulations. Changing from year to year, topics include applications of differential equations eg. planetary motion, chaotic pendulum, Lorentz force, and bound states in quantum mechanics. Numerical solutions to integral problems are exemplified for electro-magnetic fields. The focus is on applications to physics problems rather than sophisticated program code.

Practical (Tutorials):

Students work individually or in groups on their tutorial assignments and/or 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.
Some of the discussed applications are discussed in the textbook:
NJ Giordano, ***Computational Physics***, Prentice Hall (1997).
Also selected simple journal publications.

Other useful resources:

- R. de Vries, ***A First Course in Computational Physics***, Wiley, 1994.
- A.L. Garcia, ***Numerical Methods for Physics***, Prentice-Hall, 1994.
- W.H. Press et al., ***Numerical Recipes, 2nd ed.***, Cambridge University Press (various editions for different programming languages).

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
Assessment is based on continuous evaluation - Evaluation of the student's notes and computer programs.

- Questions asked by the lecturer based on the student's notes.
- Depending on time available, students make oral presentations or submit essays on projects or sections of the prescribed material.

Venue and time of assessment opportunities
Four to six evaluations of the student's notes and programs, spread evenly throughout the semester.

Turnaround time*:*
Turnaround time is typically one week. 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:
60 percent of mark: Homework (written notes and programs)
20 percent of mark: Classwork
20 percent of mark: projects (oral presentations or essays)