Faculty of Science

ASTM22, Computational Astrophysics, 7.5 credits

Beräkningsastrofysik, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2010-10-22 to be valid from 2010-10-22, spring semester 2011.

General Information

The course belongs to the fields of physics and astrophysics at the faculty of natural sciences and is given by the Department of astronomy and theoretical physics. The course is an optional course for second-cycle studies for a Degree of Master of Science (120 credits) in astrophysics. The course can also be taken as a stand alone course or as part of a Degree of Master of Science (120 credits) in physics.

The course is given in Swedish and possibly also in English.

Main field of studies	*Depth of study relative to the degree requirements*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements
Astrophysics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The aims of the course are that, upon completion of the course, the students should have acquired a deeper understanding of several numerical tools that are used within the modern astro-physical research and in other fields of research and development as well as practical experience of how to use them.

Knowledge and understanding

On completion of the course, the student should:

- be able to apply the acquired knowledge of methods and algorithms to real problems

- be able to write their own computer programs to implement these algorithms
- be able to compile, structure and analyse his or her results together with other students as a part of a project
- be able to present aims, methods and results of the projects in a clear and pedagogical way.

Competence and skills

On completion of the course, the student should:

- master basic methods for numerical solutions to the N-body problem within astrophysics
- master basic methods for numerical solutions of problems in fluid dynamics within astrophysics
- have awareness of several prevalent methods of calculation and their application to astro-physical problems
- be oriented on in which other fields of research and development areas that the methods can be applied.

Judgement and approach

On completion of the course, the student should:

- have received experience to tackle complex problems by decomposing them into their main components, find a solution and reflect on the approach chosen
- through practice have increased his or her ability to work together in groups to solve problems and present the results.

Course content

The course contains the following parts:

- Introduction to computational astrophysics.
- The N-body problem.
- Numerical algorithms.
- Smoothed Particle Hydrodynamics (SPH).
- Numerical solution of partial differential equations within astrophysics.
- Realistic simulation of the solar system as a N-body problem.
- Numerical solution of an one-dimensional system of fluid dynamics (shock tube) with SPH.
- Simulation of planetary collisions using SPH.

Course design

The teaching consists of lectures and practical exercises in the form of project work. The projects are partly carried out as group assignments. Participation in exercises and project work and other related teaching is compulsory.

Assessment

The examination is based on the reports on exercises and on the presentation of the projects.

Students who do not pass the regular exam are offered the possibility to supplement their reports and presentations.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the entire course, approved reports on exercises, passed project reports and participation in all compulsory parts are required. The final grade is determined by the results in the different parts of the examination.

Entry requirements

The prerequisites required for admission to the course are: 90 credits of completed courses (within natural sciences) including knowledge equivalent to FYSA31 (Physics 3, Modern physics), 30 credits

Further information

The course may not be credited towards a degree together with ASTM17 Statistical and numerical methods in astrophysics II 7.5 credits.

Subcourses in ASTM22, Computational Astrophysics

Applies from V11

1001 Computational Astrophysics, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction