Lund University

Faculty of Science

NUMN14, Numerical Analysis: Finite Volume Methods, 7.5 credits

Numerisk analys: Finita volymmetoder, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2007-04-12 to be valid from 2007-07-01, autumn semester 2007.

General Information

The course is an elective course for second-cycle studies for a Degree of Master of Science (120 credits) in mathematics.

Language of instruction: English and Swedish

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

Learning outcomes

The aim of the course is that students on completion of the course should have acquired the following knowledge and skills:

Knowledge and understanding

The student should obtain knowledge of mathematical and numerical difficulties of shock solutions of nonlinear hyperbolic partial differential equations. The student should obtain deep understanding of the application and development of modern methods for nonlinear conservation laws.

Skills and abilities

Student should independently be able to choose, implement and use advanced computational algorithms. The student should be able to adapt algorithms to several application problems that are modelled by conservation laws e.g. wave propagation, shock waves, groundwater waves, gas dynamics, electromagnetism, ultrasound etc. Further, the student should be able to assess the relevance and accuracy of the results.

Judgement and approach

The student should during the course

- present solutions to problems and numerical results in written form.
- write a logically well-structured report in suitable terminology on the construction of modern numerical methods and algorithms.
- write an algorithmically well-structured report, in suitable terminology, on the numerical approximation of hyperbolic conservation laws.

Course content

The course consists of one part of 7.5 credits.
Hyperbolic conservation laws and their basic properties (weak solution, energy estimates, symmetrizer,entropy, shock waves, Riemann problems, Kruzkov solution and stability in L_1). Numerical methods and their stability (upwind-, central-, and relaxation methods, TVB methods and limiters, higher order reconstructions, error estimates via Kruzkov theory). Simulation of groundwater waves and gas dynamics.

Course design

The teaching consists of lectures and computer sessions.

Assessment

Examination takes the form of written reports during the course on the computer sessions.

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 the computer sessions are required.
The final grade is determined from the joint grades on the individual reports.

Entry requirements

For admission to the course, general entry requirements, English B and knowledge equivalent to the course NUMA12 Numerical Approximation, 7.5 credits, are required.

Further information

The course may not be included in a higher education qualification together with NUM116 Numerical methods for hyperbolic PDE, 7.5 credits.

Subcourses in NUMN14, Numerical Analysis: Finite Volume Methods

Applies from H08

0701 Finite Volume Methods, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction