

# Syllabus

for course at advanced level

**Numerical Methods in Atmospheric Sciences and Oceanography**  
**Numeriska metoder i meteorologi och oceanografi**

**7.5 Higher Education  
Credits**  
**7.5 ECTS credits**

<b>Course code:</b>	MO8007
<b>Valid from:</b>	Autumn 2016
<b>Date of approval:</b>	2016-11-21
<b>Department</b>	Department of Meteorology
<b>Main field:</b>	Meteorology
<b>Specialisation:</b>	A1F - Second cycle, has second-cycle course/s as entry requirements

## Decision

This syllabus has been approved by the Board of Science at the Faculty of Science, Stockholm University 2016-11-21.

## Prerequisites and special admittance requirements

Knowledge corresponding to Atmospheric Physics and Chemistry, 30 HECs (MO4000) or Meteorology I, 15 HECs (MO8001) and Meteorology II, 7.5 HECs (MO8002). Also required is knowledge equivalent to English B/6.

## Course structure

Examination code	Name	Higher Education Credits
HELA	Numerical Methods	7.5

## Course content

The course deals with numerical methods to solve the hydrodynamic equations. It includes:

- finite differences in time and space for the hydrodynamic equations
- analysis of the limitations of finite difference methods
- semi-implicit and semi-Lagrangian schemes
- iterative methods for solving the Laplace and Poisson equations
- staggered grids for the shallow-water equations in two dimensions
- nonlinear advection terms
- spectral coordinates for global atmospheric circulation models

## Learning outcomes

After taking this course the student is expected to be able to:

- discretise hydrodynamic equations
- explain the limitations caused by discretisation (precision, instability, numerical modes, phase velocity, resolution)
- implement a shallow-water model numerically
- solve the Laplace and Poisson equations numerically using three different methods

## Education

The teaching consists of lectures, calculation exercises and laborations. Participation in laborations and the associated group tutorials is compulsory. If there are special reasons, the Examiner may, after consulting the

course teacher, allow the student to omit certain parts of the compulsory teaching.

### **Forms of examination**

- a) Examination is done by a written test.
- b) Grading is done on a seven-step scale: A = Excellent B = Very good C = Good D = Satisfactory E = Sufficient Fx = Failed, some more work is required F = Failed, a lot more work is required.
- c) The grading criteria are handed out at the beginning of the course.
- d) For passing the course, at least grade E is required, as well as participation in all compulsory teaching.
- e) Students that do not pass the regular test have the right to take further tests as long as the course is given. The number of tests is not limited. As "tests" are understood also other compulsory parts of the course. Students that have passed a test are not allowed to attempt another test in order to receive a higher grade. Students that have failed an examination twice, for a course or part of a course, have the right to request that another Examiner is appointed, unless special reasons speak against this. The request for this should be directed to the Board of the department. The course has at least two examination occasions per academic year the years teaching is given. Intermediate years at least one examination occasion is given.
- f) A student who receives grade Fx has the opportunity to do additional work in order to reach grade E. The Examiner decides what additional work is required and the criteria to pass. The additional work should be performed prior to the next examination occasion.

### **Interim**

Students may request that the examination is performed according to this syllabus even after it has ceased to be valid. However, this may be done no more than three times during a two-year period after the course was last given. The request for this should be directed to the Board of the department. This applies even if the syllabus is revised.

### **Limitations**

The course may not be included in a degree together with Meteorology, 10p (ME3580), Numerical Methods in Atmospheric Sciences and Oceanography, 7.5p (MO7004) or equivalent.

### **Misc**

The course is a part of the Master's programme in Meteorology, Oceanography and Climate, but may also be taken as an individual course.

### **Required reading**

The course literature is decided by the Board of the department and published on the Department of Meteorology's website at least two months prior to course start.