FSG3122 Wave Motions and Hydrodynamic Stability 7.5 credits

Vågrörelser och hydrodynamisk stabilitet

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FSG3122 valid from Autumn 2010

Grading scale

Education cycle

Third cycle

Specific prerequisites

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

The student will acquire knowledge in fundamental concepts and phenomena in wave motions in fluids and hydrodynamic instabilities. It will help you to understand the theory underlying some commonly observed flow phenomena, such as

- why the surface waves behind a boat have a limited spreading angle
- why the wake of a cylinder beats at a fixed frequency independently of the external disturbances
- why Tsunamis arise and how they behave when approaching the shore
- why the so spectacular Billow clouds in the atmosphere are formed

Course contents

After completing this course the student should be able to

- describe the behaviour of surface gravity waves
- explain the concept of group velocity of a wave
- describe the main features of internal waves in continuously stratified fluids, such as the oceans and in the atmosphere
- identify the mechanisms behind instabilities in flows governed by thermal convection and heat exchange
- discuss effects of centrifugal and Coriolis forces in unstable rotating systems
- describe the instability nature and mechanisms in shear flows, i.e. wake, jet, boundary layer and channel flows
- discuss the influence of viscosity on stability
- explain why classic asymptotic stability analysis provides only a partial description of disturbance amplification in shear flows

Disposition

The teaching is deliverd by means of a mixture between traditional classroom teaching and seminar-based lectures where open discussions will be promoted by student-active-elements such as gobbets. Furhtermore, table experiments will be shown during classes in order to demonstrate and clarify parts of the surveyed theory. In order to activate the students to develop practical skills one experimental and one numerical assignment are given in this course. Each lecture will begin with a few minutes review and discussion of last lecture's content. The total amount of lecture hours is 42h, which are delivered over 21 gatherings (i.e. 2h per lecture).

Course literature

- Acheson D.J., Elementary Fluid Dynamics, Oxford University Press, USA, 1990 (ISBN 0198596790).
- Kundu P.K. & Cohen I.M., Fluid Mechanics, Elsevier Academic Press, USA, 2004 (ISBN 0121782530).
- Your own lecture notes and other distributed material.

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

The examination is composed of an alternating oral and written test. The test is usually performed in groups of two students and will last for about 45 minutes, including the presentation of the numerical assignment. A list of about 50 questions will be available from the course home page from where questions will be taken and asked at the individual test.

Other requirements for final grade

The following three items have to be approved in order to obtain a pass of the course (7.5c):

- One laboration with adherent preparation tasks and lab report (for graduate students the lab report has to be an extended version) E**xperimental analysis of Tollmien-Schlichting waves over a flat plate**(1.5c)
- One home assignment with report (for graduate students some Matlab programming is required and the presentation at the oral exam has to be an extended version) **Numerical computation of flow instability for different configurations** (1.5c)
- Oral/written examination (4.5c)

All items are graded. For graduate students the highest grade is required to obtain a pass.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.