



DEPARTMENT OF PHYSICS

FYM155 Dynamical systems, 7.5 credits

Dynamiska system, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2024-01-31 to be valid from 2024-09-02, autumn semester of 2024.

Field of education: Science 100%

Department: Department of Physics

Position in the educational system

elective course

The course can be part of the following programmes: 1) Complex Adaptive Systems, Master's Programme (N2CAS) and 2) Physics, Master's Programme (N2PHY)

Main field of studies

Physics

Physics with Specialization in Materials
and Biological Systems

Specialization

A1N, Second cycle, has only first-cycle
course/s as entry requirements

A1N, Second cycle, has only first-cycle
course/s as entry requirements

Entry requirements

A Bachelor's degree in physics, mathematics, or equivalent, including course in programming.

Applicants must prove their knowledge of English: English 6/English B from Swedish Upper Secondary School or the equivalent level of an internationally recognized test, for example TOEFL, IELTS.

Learning outcomes

The aim of the course is to give an understanding of theoretical concepts and practical

aspects arising in the description of nonlinear dynamical systems: how is chaos measured and characterised? How can one detect deterministic chaos in an experimental time series? How can one control and predict chaotic systems? Applications in physics, biology, and economics are described.

Learning outcomes (after completion of the course the student should be able to)

After successfully completing this course the students shall be able to

understand and explain key concepts in regular dynamical systems;
 perform linear stability analysis, and understand its limitations;
 analyze qualitative changes in the system as control parameters change (bifurcations);
 understand and explain the key concepts used in describing deterministic chaos in non-linear systems;
 efficiently simulate dynamical systems on a computer;
 numerically compute Lyapunov exponents and fractal dimensions;
 efficiently search for periodic orbits and determine their stabilities;
 recognize and analyse chaotic dynamics in initially unfamiliar contexts;
 present numerical results graphically in a clear and concise manner;
 communicate results and conclusions in a clear and logical fashion.

Course content

Regular dynamics:

Continuous flows.

Fixed points and stability analysis.

Characterisation of linear and non-linear flows.

Bifurcations och structural stability.

Index theory.

Periodic motion, limit cycles and relaxation oscillators.

Chaotic dynamics:

Lyapunov exponents.

Strange attractors.

Fractal dimension, fractals in physical systems.

Transitions to chaos.

Chaos and regular dynamics in Hamiltonian systems.

Form of teaching

Lectures, set of homework problems, examples classes, and written exam.

Language of instruction: English

Assessment

The final grade is based on four sets of homework assignments (50%) and a written examination (50%).

If a student who has twice received a failing grade for the same examination component wishes to change examiner ahead of the next examination session, such a request should be made to the department in writing and should be approved by the department unless there are special reasons to the contrary (Chapter 6 Section 22 of the Higher Education Ordinance). If a student has received a recommendation from the University of Gothenburg for study support for students with disabilities, the examiner may, where it is compatible with the learning outcomes of the course and provided that no unreasonable resources are required, decide to allow the student to sit an adjusted exam or alternative form of assessment. In the event that a course has ceased or undergone major changes, students are to be guaranteed at least three examination sessions (including the ordinary examination session) over a period of at least one year, but no more than two years after the course has ceased/been changed. The same applies to internships and professional placements (VFU), although this is restricted to just one additional examination session.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

Course evaluation

The results of and possible changes to the course will be shared with students who participated in the evaluation and students who are starting the course.