



Exchange programme Vrije Universiteit

Vrije Universiteit Amsterdam - Exchange programme Vrije Universiteit - 2022-2023

Exchange

Vrije Universiteit Amsterdam offers many English-taught courses in a variety of subjects, ranging from arts & culture and social sciences, neurosciences and computer science, to economics and business administration.

The International Office is responsible for course approval and course registration for exchange students. For details about course registration, requirements, credits, semesters and so on, please [visit the exchange programmes webpages](#).

Dynamics and Computation

Course Code	X_400647
Credits	6.00
Period	P4+5
Course Level	200
Language Of Tuition	English
Faculty	Faculty of Science
Course Coordinator	dr. S.B. Dubinkina
Examiner	dr. S.B. Dubinkina
Teaching Staff	dr. S.B. Dubinkina
Teaching method(s)	Partial Exam, Seminar, Lecture, Practical

Course Objective

At the end of the course,

1. the student is able to analyse one and two- dimensional differential equations systems
2. the student is able to linearise a non-linear system, compute corresponding eigenvalues (by hand and numerically), solve Initial Value Problems and draw conclusions on the stability of fixed points
3. the student is able to analyse scalar difference equations, their fixed points and stability properties, find period doubling points for simple systems, and sketch orbits
4. the student is able to write programs in Matlab for numerical computations
5. the student is able to numerically solve systems of nonlinear equations
6. the student is able to fit nonlinear data using least squares methods
- 7 the student is able to use Fast Fourier Transforms to analyse signals
8. the student is able to use sparse matrices to compute dominant eigenvalues and eigenvectors for large matrices
9. the student is able to numerically integrate systems of ordinary differential equations
10. the student is able to write reports documenting how the matlab programs work and discuss their limitations.

Course Content

In this course you will be given an overview of the theory of discrete and continuous dynamical systems (first period), as well as a foundation in the most commonly applied numerical algorithms used to solve algebraic and dynamic problems (second period) found in concrete applications.

Dynamical Systems part:

1. Discrete-time dynamical systems: graphical methods to draw orbits, calculating fixed points, stability analysis, period doubling.
2. Ordinary Differential Equations in 1 and 2 dimensions: graphical methods, linearisation, phase plane analysis, classification of steady states.
3. General theory of linear ODEs, solving initial value problems.

Numerical part

1. Introduction in Matlab programming
2. Finding roots of systems of nonlinear equations
3. Interpolation, Least Squares
4. Fast Fourier Transforms, analysing signals
5. Computing eigenvalues and eigenvectors, Pagerank
6. Numerical derivatives and integrals of functions.
7. Numerical methods for ODEs

Additional Information Teaching Methods

lectures, tutorials, computer labs

Method of Assessment

Written exam (part 1) and computer programming exercises (part 2). Both form 50% of the grade and both need to be passed to complete the entire course. There is a resit for the first exam but none for the second part. Students that have not passed the second part by a small margin (max 1.0 pt) get the opportunity to hand in one or more additional assignments to obtain a sufficient grade.

Literature

S. H. Strogatz. Nonlinear Dynamics and Chaos. ISBN: 978-0738204536

Additional Information Target Audience

2 BA

Additional Information

We expect that you attend the tutorials well prepared! That means that you have already tried to make the exercises/or started coding an assignment at home! Some exercises will be treated on the blackboard. You can ask questions about other exercises or the assignments to the teaching assistant. An attendance list will be used.

Recommended background knowledge

Linear Algebra, Calculus 1 and 2