

Modelleren van complexe systemen (C004453)

Cursusomvang *(nominale waarden; effectieve waarden kunnen verschillen per opleiding)*

Studiepunten 6.0 **Studietijd 180 u**

Aanbodsessies in academiejaar 2025-2026

A (semester 2) Engels Gent

Lesgevers in academiejaar 2025-2026

De Buyl, Sophie	VUB	Verantwoordelijk lesgever
Gelens, Lendert	VUB	Medelesgever

Aangeboden in onderstaande opleidingen in 2025-2026

	stptn	aanbodsessie
Educatieve Master of Science in de wetenschappen en technologie (afstudeerrichting fysica en sterrenkunde)	6	A
Master of Science in de fysica en de sterrenkunde	6	A
Master of Science in Physics and Astronomy	6	A

Onderwijstalen

Engels

Trefwoorden

Situering

<https://caliweb.vub.be/?page=course-offer&id=004928&anchor=1&target=pr&year=2223&language=en&output=html>

The overall objective of this course is to be able to analyze dynamical systems using geometrical methods on the phase space. This includes carrying out linear stability, bifurcation and phase plane analyses. We will first focus on one and two dimensional systems. Chaotic phenomena in physical systems will be described with two classical examples: the Lorentz strange attractor and the logistic map. Solving problems and reading literature related to the course material is also foreseen.

Inhoud

- General introduction about linear versus nonlinear dynamics.
- Dynamical systems with one variable.
- Bifurcations in one variable systems: saddle-node, cusp, transcritical and imperfect bifurcations.
- Bifurcations on the circle, synchronisation.
- Linear dynamics with two variables: classification of the fixed points (saddle, node, center, degenerate).
- Nonlinear dynamics with two variables: phase space analysis, reversibility, Lyapunov function, theory of the index.
- Limit cycles: relaxation oscillations, singular perturbation.
- Chaos: Lorentz model and analysis.
- One dimensional maps: bifurcations, period doubling and intermittency route to chaos, universality.
- Fractals: self-similarity, fractal dimension.
- Strange attractors: stretching and folding, baker's map, Henon map.
- Pattern formation.

Begincompetenties

Eindcompetenties

To be able to analyze dynamical systems using geometrical methods on the phase space. This includes carrying out linear stability, bifurcation and phase plane analyses.

Creditcontractvoorwaarde

Toelating tot dit opleidingsonderdeel via creditcontract is mogelijk na gunstige beoordeling van de competenties

Examencontractvoorwaarde

Dit opleidingsonderdeel kan niet via examencontract gevolgd worden

Didactische werkvormen

Werkcollege, Hoorcollege, Zelfstandig werk

Studiemateriaal

Geen

Referenties

Vakinhoudelijke studiebegeleiding

Evaluatiemomenten

periodegebonden evaluatie

Evaluatievormen bij periodegebonden evaluatie in de eerste examenperiode

Mondelinge evaluatie, Schriftelijke evaluatie

Evaluatievormen bij periodegebonden evaluatie in de tweede examenperiode

Mondelinge evaluatie, Schriftelijke evaluatie

Evaluatievormen bij niet-periodegebonden evaluatie

Tweede examenkans in geval van niet-periodegebonden evaluatie

Niet van toepassing

Toelichtingen bij de evaluatievormen

The final grade is composed based on the following categories:

Oral Exam determines 60% of the final mark.

PRAC Presentation determines 40% of the final mark.

Within the Oral Exam category, the following assignments need to be completed:

Written exam with a relative weight of 60 which comprises 60% of the final mark. This is a mid-term test.

Note: oral exam with a written preparation (theory and exercises)

Within the PRAC Presentation category, the following assignments need to be completed:

Presentation with a relative weight of 40 which comprises 40% of the final mark.

Note: presentation of group work (during the classes)

Eindscoreberekening

- oral exam with a written preparation (theory and exercises) for 60% of the final grade.
- presentation of a group projet (during one of the classes) for 40% of the final grade.