GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2018-2019

Mathematical Modeling (C004010)

Course size (nominal values; actual values may depend on programme)

Credits	6.0	Study time	180 h
Contact hrs	60.0 h		

Course offerings and teaching methods in academic year 2018-2019

A (semester 2)	Dutch	seminar: practical PC room classes	15.0 h
		lecture	30.0 h
		seminar: coached exercises	15.0 h

Lecturers in academic year 2018-2019

Van Daele, Marnix	WE02	lecturer-in-charge

Offered in the following programmes in 2018-2019	crdts	offering
Bachelor of Science in Mathematics	6	A

Teaching languages

Dutch

Keywords

model, modelling, model reductiion
differential equation
dynamical system, bifurcation

Position of the course

Chronologically this is one of the last courses in the bachelor program in mathematics that is mandatory for all students. It relies on the knowledge acquired in several previous courses (linear algebra, analysis, numerical analysis) and points to practical applications of this knowledge.

Contents

By means of concrete examples one illustrates modeling by means of continuous and discrete models, deterministic and stochastic models. In particular in the continuous, deterministic case attention is paid to ordinary and partial differential equations, delay differential equations, differential algebraic equations, integro-differential equations and fractional differential equations.
In particular special attention is devoted to Sturm-Liouville problems (as an example of eigenvalue problems) and Hamiltonian problems (whose solutions are known to be symplectic).
A qualitative analysis of one-dimensional and two-dimensional dynamical systems with the introduction of general concepts op dynamical systems and bifurcation theory.
Singular value decomposition; model reduction

Initial competences

Final competences of the courses Analysis I, Linear Algebra and Geometry I and Numerical Analysis.

Final competences

1 To know modelling techniques and interpret them.
2 Know which bifurcations can be expected in particular situation. Compute bifurcation points and their normal form. Do a complete two-parameter bifurcation analysis.
3 Understand properties of solutions of some specific problems (such as Sturm-Liouville problems and Hamiltonial problems)
4 Be able to compute the singular value decomposition and to have insight in

applications of this decomposition.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, seminar: coached exercises, seminar: practical PC room classes

Extra information on the teaching methods

Exercises with paper and pencil, but also with computer and specialized software.

Learning materials and price

Syllabus (.pdf) with theory and a choice of exercises and study assignments via the electronic environment Minerva, additional material like extra exercises and solutions of exercises.

References

The Princeton Companion to Applied mathematics, editor Nicholas J. Higham, Princeton University Press, 2015
Numerical Solution of Sturm-Liouville Problems, Johan D. Pryce, Clarendon Press, 1993,
Numerical Linear Algebra, Lloyd N. Trefethen, David Bau, III, Siam, Philadelphia, 1997

Course content-related study coaching

Individual contact with the lecturer, electronic environment Minerva.

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Written examination

Examination methods in case of periodic evaluation during the second examination period

Written examination

Examination methods in case of permanent evaluation

Oral examination, assignment

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

End-of-term evaluation: written examination at the end of the semester.
Permanent evaluation: handed in projects.
The evaluation evaluates both the practical (programming an algorithm in a project) as well as the theoretical skills (knowledge of basic definitions, understanding of derivations, ...).

Calculation of the examination mark

Theory: 8 marks (out of 20).
Exercises: 8 marks (out of 20).
Project : 4 marks (out of 20).