GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2017-2018

Modelling and Simulation with Partial Differential Equations in Practice (I002157)

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

Credits	**5.0**	**Study time**	**135 h**
Contact hrs	60.0 h		

Course offerings and teaching methods in academic year 2017-2018

A (semester 1)	English	lecture	25.0 h
	English	group work	17.5 h
	English	seminar: practical	17.5 h

Lecturers in academic year 2017-2018

Nopens, Ingmar	LA10	lecturer-in-charge
Baetens, Jan	LA10	co-lecturer

Offered in the following programmes in 2017-2018	crdts	offering
Master of Science in Bioscience Engineering: Chemistry and Bioprocess Technology	5	A
Master of Science in Bioscience Engineering: Food Science and Nutrition	5	A
Master of Science in Bioscience Engineering: Environmental Technology	5	A

Teaching languages

English

Keywords

Partial differential equations; Computational Fluid Dynamics (CFD); numerical techniques

Position of the course

This course constitutes a continuation of the Bachelor course Modelling and Simulation of Biosystems, which is restricted to models based upon ordinary differential equations. Since most models for describing real-world phenomena are based upon partial differential equations, this course provides the insights and tools that are needed for developing and understanding such models.

Contents

I. Introduction
- Basic math of partial differential equations (PDEs)
- Partial differential equations frequently used for describing environmental and biochemical industrial processes

o Reaction-diffusion equation
o Convection-diffusion equation
o Wave equation
o Navier-Stokes equation

II. Simulating PDE-based models
- Finite difference method

o Methods for elliptic equations
o Methods for parabolic equations
o Methods for hyperbolic equations
- Finite element method

o Weak formulation
o Meshing methods
o Weighted residuals and Galerkin method
- Finite volume method

III. Computational Fluid Dynamics (CFD)
• Formulation
o Navier-Stokes equations
o Turbulence modeling
o Species equations
• Incorporating kinetics into CFD

Initial competences

Modelling and Simulation 2: Partial Differential Equations in Practice builds on certain learning outcomes of course units 'Mathematics3: Differential Equations', 'Physics 4: Physical Transport Phenomena' and Modelling and Simulation of Biosystems ; or the learning outcomes have been achieved differently.

Final competences

Conditions for credit contract

Access to this course unit via a credit contract is unrestricted: the student takes into consideration the conditions mentioned in 'Starting Competences'

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Group work, lecture, seminar: practical PC room classes

Learning materials and price

Syllabus (electronic)

References

Kwong, Y. W. and Bang, H. (1996). The finite element method using MATLAB. CRC Press. Ramkrishna D. (2000). Population balances: theory and applications to particulate systems in engineering. Academic Press.

Course content-related study coaching

Study coaching is offered before and after each of the theory lectures and computer laboratories or after appointment

Evaluation methods

end-of-term evaluation

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

Open book examination, oral examination, report

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

Open book examination, oral examination, report

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

The student defends his/her report of a simulation exercise

Calculation of the examination mark

Students who eschew period aligned and/or non-period aligned evaluations for this course unit may be failed by the examiner