GHENT UNIVERSITY

Course Specifications

From the academic year 2017-2018 up to and including the

Modelling and Simulation (C003786)

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 1)	Dutch	seminar: coached exercises	15.0 h
		seminar: practical PC room classes	15.0 h
		lecture	30.0 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 Computer Science	6	A

Teaching languages

Dutch

Keywords

Fourier analysis, ordinary and partial differential equations, multidimensional integrals, random numbers

Position of the course

Learn several mathematical topics from the field of analysis. This will give the student access to some important subfields or application fields of informatics such as statistical informatics, applications in scientific computing, electronic aspects of information processing, algorithms for image compression and image processing, ... Some of the subjects will be treated both analytically as well as numerically.

Contents

1. Fourier series and the Fourier transform
- analytically : Euler's formula for Fourier series of a periodic function
- numerically: trigonometric interpolation leads to DFT; FFT: a special implementation of the DFT; from DFT to DCT; wavelets

2. Differential equations
- ordinary differential equations:

1 analytical solution of some specific classes
2 numerical solution with special attention for
  - linear multistep methods, Runge-Kutta methods, PC-pairs, ...
  - accuracy and stability
  - initial value problems and boundary value problems

- partial differential equations

1 classification into equations of parabolic, hyperbolic and elliptic type and some specific solution techniques
2 some numerical solution techniques (semi-discretisation and complete discretisation)

3. Random numbers and simulation
4. Computation of multidimensional integrals
- theoretical aspects such as coordinate transformations
- numerical aspects (quadrature formulae, Monte-Carlo methods, ...)

Initial competences

- The students have obtained the final competences of the courses Discrete Mathematics, Calculus, Linear algebra and geometry and Scientific computing.

Final competences

1 Determine the Fourier series expansion of a periodic function and know to what it converges in every point. Compute and apply Fourier and Laplace transforms. Have insight in the DFT and FFT algorithms. Understand the relation between DFT and FFT.
2 Solve a number of special types of ordinary differential equations. Know the structure of the solution space of a linear differential equation.
Be able to use numerical techniques for solving ordinary differential equations in initial value problems and in boundary value problems.
3 Solve a partial differential equation either by separation of variables or by using the fundamental solutions of d'Alembert.
Be able to apply different types of numerical methods, based on full discretisation or based on semi-discretisation.
4 Compute multidimensional integrals analytically as well as numerically.
5 Understand how random number generators work and be able to apply them.

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: both paper and pencil exercises and exercises with computer.

Learning materials and price

A syllabus with theory and a choice of exercises, additional material via Minerva such as solutions to exercises, examination questions from previous years.
Price : about € 10.

References

M. Heath, Scientific computing, an introductory survey, second Edition, Mc Graw Hill, 2002, ISBN 0-07-239910-4

Course content-related study coaching

Individual contact with the lecturer, use of the electronic teaching 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

Assignment

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

Examinations on theory and exercises are in written form; in the exercises part a computer can be used. There is a closed-book part (mainly theory) and an open-book part (exercises).

Calculation of the examination mark

8 marks for the theoretical examination (out of 20).
8 marks for the exercise part (out of 20).
4 marks for the project (out of 20).