GHENT UNIVERSITY

Course Specifications

From the academic year 2019-2020 up to and including the academic year

Applied Functional Analysis (C001307)

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

Credits 6.0 **Study time 165 h** **Contact hrs** 45.0h

Course offerings and teaching methods in academic year 2022-2023

null

Lecturers in academic year 2022-2023

Slodicka, Marian	TW06	lecturer-in-charge

Offered in the following programmes in 2022-2023	**crdts**	**offering**
null		

Teaching languages

Dutch

Keywords

Functional analysis, variational calculus, initial and boundary value problems, applications

Position of the course

The intention of this course is to give the students an introductory but efficient matter consisting of terms, results and methods from functional analysis.
This will be illustrated on some simplified practical applications coming from various engineering disciplines.
The fundamental concepts of the operator and spectral theory will be explained and applied to diverse problems.

Contents

1. Bounded (compact) linear operators in Banach and Hilbert spaces.
Fundamental theorems in Banach and Hilbert spaces (Hahn-Banach theorem, Riesz representation theorem, uniform boundedness theorem, closed graph theorem,...).
Applications of the Banach fix-point theorem to PDE's and integral equations. Spectral theory for compact linear operators in normed spaces, operator equations, Fredholm alternative. Applications to integral equations.
2. Transient variational problems.
Semigroup theory for parabolic problems. Rothe method for linear and nonlinear BVP's of parabolic types. Interior time-continue approximation, convergence, error estimates.
3. Theory of monotone operators
Gateaux and Frechet derivative, potential and monotone operators, minimum of non-linear functionals, solvability of nonlinear monotone problems.

Initial competences

Mathematical analysis, linear algebra, function spaces, differential equations

Final competences

1 Knowledge of fundamental theorems of functional analysis in Banach and Hilbert spaces, spectral theorie for linear operators.
2 Knowledge of functional analytical treatment for steady-state and time dependent BVP's, variational framework, weak solutions.
3 Reformulation of problems in terms of minimization of an quadratic functional.
4 Knowledge of the semigoup theory and the Rothe method with application to evolution problems.
5 Creative treatment of interior approximations with applications to problems from

diverse engineering disciplines.

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

Seminar, Lecture

Learning materials and price

Lecture notes in English.
Cost: 10 EUR

References

1 D. H. Griffel, Applied functional analysis, (2nd ed.), Wiley, New-York, 2002.
2 E. Kreyszig, Introductory functional analysis with applications, Wiley, New-York, 1989.
3 J. L. Nowinsky, Applications of functional analysis in engineering, Plenum Press, New-York, 1981.
4 A. Pazy, Semigroups of linear operators and applications to partial differential equations, Springer, New-York, 1983.
5 M. Pedersen, Functional analysis in applied mathematics and engineering, Chapman & Hall, Boca Raton, 2000.
6 K. Rektorys, Variational methods in mathematics, science and engineering, D. Reidel Publishing, Dordrecht, 1980.
7 E. Zeidler, Applied functional analysis, Springer, New-York, 1995.
8 M.M. Vajnberg, Variational Method and Method of Monotone Operators in the Theory of Nonlinear Equations, John Wiley & Sons, Chichester, 1973.

Course content-related study coaching

The subject will be explained in details during the lectures. Additional (personal or via E-mail) consultations are possible.

Assessment moments

end-of-term assessment

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

Written examination with open questions

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

Written examination with open questions

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

Theory - closed book exam
Problems - open book exam

Calculation of the examination mark

Theory - 75% points
Problems - 25% points