Linnæus University

Dnr: LNU-2024/241

Course syllabus

Faculty of Technology
Department of Mathematics

4MA901 Introduktion till tillämpad analys, 7,5 högskolepoäng
Introduction to Applied Analysis, 7.5 credits

Main field of study
Mathematics

Subject
Mathematics

Level
Second cycle

Progression
A1N

Date of Ratification
Approved 2024-01-29.
The course syllabus is valid from autumn semester 2024.

Prerequisites
Courses in mathematics totalling at least 45 credits, including courses in linear algebra and multivariable analysis.

Objectives

After completing the course, the student should be able to:

Knowledge and understanding

- A.1 show an understanding of infinite-dimensional function spaces that are central to optimization and partial differential equations
- A.2 explain the relevance of key concepts to the content of the course
- A.3 apply fixed point theorems to mathematical models,

Skills and abilities

- B.1 demonstrate an in-depth ability to formulate, based on a general question an adequate mathematical problem, and use and integrate knowledge from applied analysis to analyze, structure and solve problems

Valuation skills and attitudes

- C.1 demonstrate the ability to interpret, compare and evaluate methods in applied analysis taking into account relevant scientific aspects.

Content

The course introduces advanced level concepts in mathematics in functional analysis and theory that have direct applications in probability theory, analysis and numerical solution of integral equations, partial differential equations, optimization and machine learning.

The course includes the following topics:

- Measures, measurable functions, Lebesgue integral, and applications.
- Banach spaces and Lp-spaces.
- Hilbert spaces, Sobolev spaces, dual spaces, trace sets, compactness and Poincaré inequalities.
- Fixed point theorems with applications to integral and differential equations.
- Minimization of energy functionals and its relation to partial differential equations

Type of Instruction

Lectures and teacher-led meetings related to assignments. Assignments are presented orally and in writing.

Examination

The course is assessed with the grades A, B, C, D, E or F.

The grade A constitutes the highest grade level, the remaining grades follow in descending order where the grade E constitutes the lowest grade level for passing. The grade F means that the student's performance has been assessed as failed.

For a passing grade on the course, at least grade E on Theory and Methods and grade G on UPG1-3.

The final grade is determined by the grade in Theory and Methods.

All graded examinations consist of two or more grades for written and oral presentations that together form the basis for grading of the graded examination component.

For the assignments, results from both written and oral presentations are noted.

The assignments are examined individually. For the theory and methods component, results from both oral and written presentations. The module is examined individually.

Resit examination is offered in accordance with Linnaeus University’s Local regulations for courses and examination at the first- and second-cycle levels. In the

event that a student with a disability is entitled to special study support, the examiner will decide on adapted or alternative examination arrangements.

Objectives achievement

The examination of the course is divided as follows:
Module 2401 Assignments 1 1.5 credits with the grading system UG
Module 2402 Assignments 2 1.5 credits with the grading system UG
Module 2403 Assignments 3 1.5 credits with the grading system UG
Module 2404 Theory and method 3.0 credits with the grading system AF

The examination elements are linked to the course objectives in the following ways:
Module 2401 links to the course objectives: A.1, A.3, B.1, C.1
Module 2402 links to the course objectives: A.1, A.3, B.1, C.1
Module 2403 links to the course objectives: A.1, A.3, B.1, C.1
Module 2404 links to the course objectives: A.1, A.2, A.3, C.1

Course Evaluation

A course evaluation should be conducted during the course or in connection with its conclusion. The results and analysis of the completed course evaluation should be promptly communicated to students who have completed the course. Students participating in the next course instance should be informed of the results of the previous course evaluation and any improvements that have been made, no later than at the start of the course.

Overlap

The course cannot be included in a degree along with the following course/courses of which the content fully, or partly, corresponds to the content of this course:
2.5 credits with 4MA415 Functional Analysis and 2.5 credits with 4MA411 Integration Theory.

Other Information

The course is conducted in such a way that the experience and knowledge of the course participants are made visible and developed. This means, for example, that we have an inclusive approach and strive to ensure that no one feels excluded. This can manifest itself in different ways in a course, for example by the teacher using gender-neutral examples.

Required Reading and Additional Study Material

Required literature Zeidler, Eberhard: *Applied functional analysis with subtitle Applications to mathematical physic*s, latest edition, Springer-Verlag, (200) 479 pages.

Alt, Hans Wilhelm: *Linear functional analysis*, latest edition, Springer-Verlag, 30 (418) pages.

Material from the department.