Faculty of Science

MATP35, Mathematics: Linear Functional Analysis, 7.5 credits

Matematik: Linjär funktionalanalys, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2019-12-04 to be valid from 2019-12-04, autumn semester 2020.

General Information

The course is an elective course for second-cycle studies for a Degree of Master of Science in mathematics.

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Mathematics	A1F, Second cycle, has second-cycle course/s as entry requirements

Learning outcomes

The main goal of the course is to give a presentation of the principles of functional analysis and their applications. These include the basic properties of Banach and Hilbert spaces as well as the spectral theory of bounded and compact linear operators.

Knowledge and understanding

After completing the course the student should be able to:

- give a detailed account of the concepts, theorems and methods within functional analysis that are treated in the course,
- identify the main theorems of the course, describe the main ideas and carry out the steps in their proofs,
- give examples of non-trivial situations where these theorems apply.

Competence and skills

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

- integrate knowledge from the different parts of the course in connection with problem solving,
- identify problems that can be solved by methods that are part of the course and use appropriate solution methods,
- explain the solution to related mathematical problems in speech and in writing, logically coherent and with adequate terminology.

Judgement and approach

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

- identify situations where the methods of functional analysis apply, for example in other areas such as ordinary and partial differential equations, function spaces, operator theory.

Course content

The course treats fundamental properties of Banach and Hilbert spaces and the bounded linear operators defined on them:

- Banach spaces, the Hahn-Banach Theorem, weak convergence and weak precompactness of the unit ball.
- Hilbert spaces. Examples including L2 spaces. Orthogonality, orthogonal complement, closed subspaces, projection theorem. Riesz Representation Theorem.
- Orthonormal sets, Bessel's inequality. Complete orthonormal sets, Parseval's identity.
- Baire Category Theorem and its consequences for operators on Banach spaces (uniform boundedness, open mapping, inverse mapping and closed graph theorems). Strong convergence of sequences of operators.
- Bounded and compact linear operators on Banach spaces and their spectra.
- The spectral theorem for compact self-adjoint operators on Hilbert spaces.

Course design

The teaching consists of lectures and seminars.

Assessment

The examination consists of a written examination and an oral examination. The oral examination may only be taken by those students who passed the written examination. Students who fail the regular written examination are offered a resit examination shortly thereafter.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the course it is required to pass the written and the oral examination. In addition, the grade Pass with distinction requires that the total number of points obtained in the written and the oral examination is at least 75% of the total maximum number of points. The maximum number of points that can be obtained in the written and the oral examination are weighted three to one.

Entry requirements

For admission to the course, English 6 is required as well as at least 90 credits in pure mathematics including knowledge corresponding to a course in Integration Theory, 7.5 credits (Lebesgue integral).

Further information

The course may not be included in degree together with MATP15 Linear functional analysis, 7.5 credits.

Subcourses in MATP35, Mathematics: Linear Functional Analysis

Applies from H20

2001 Written examination, 5,0 hp
Grading scale: Fail, Pass
2002 Oral examination, 2,5 hp
Grading scale: Fail, Pass