Faculty of Science

MATP43, Mathematics: Representation Theory of Quivers and Algebras, 7.5 credits

Matematik: Representationsteori för koger och algebror, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2022-06-03 to be valid from 2022-06-03, spring semester 2023.

General Information

The course is an elective course for second-cycle studies for a Degree of Master of Science (120 credits) 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 course aims to provide an introduction to the representation theory of quivers and algebras with particular emphasis on concrete examples and explicit computations. Also, the course gives an introduction to the basic language of category theory with focus on its use in algebraic subject areas.

Knowledge and understanding

After completing the course the student should be able to:

- explain in detail the concepts, theorems and methods included in the course,
- identify the most important theorems in the course and present their proofs.

Competence and skills

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

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

Judgement and approach

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

- argue for the importance of representation theory of quivers and algebras in relation to matrix problems in linear algebra, and explain its relationship to the combinatorics of root systems,
- argue for the importance of the language of category theory in representation theory of quivers and algebras.

Course content

The course treats:

- *Representation theory of quivers and algebras:* Algebras and their modules; the path algebra of a quiver; the Gabriel quiver of an algebra; classes of representations (projective, injective, simple, indecomposable); the Jordan–Hölder Theorem; the Krull–Remak–Schmidt Theorem; the Grothendieck group of a finite-dimensional algebra; root systems and their Weyl groups; Bernstein–Gelfand–Ponomarev reflection functors; Gabriel's Theorem on quiver representations; Yoneda extension spaces.
- *Basic category theory*: Categories, functors, natural transformations, adjunctions, universal properties. Abelian categories, additive categories.

Course design

The teaching consists of lectures and seminars.

Assessment

The examination consists of a written examination followed by an oral examination at the end of the course. The oral examination may only be taken by those students who passed the written examination. Students who fail the ordinary 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 not less than 75% of the accumulated maximal numbers of points. The maximal 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/B is required as well as at least 90 credits in pure mathematics, including the course MATM31 Algebraic structures, 7.5 credits or equivalent.

Further information

Knowledge corresponding to the course MATP33 Group and Ring Theory, 7.5 credits, is recommended but not compulsory.

The course is offered at the Centre for Mathematical Sciences, Lund University.

Subcourses in MATP43, Mathematics: Representation Theory of Quivers and Algebras

Applies from V23

2301 Written Examination, 5,0 hp
Grading scale: Fail, Pass
2302 Oral Examination, 2,5 hp
Grading scale: Fail, Pass