FSF3608 Clifford Algebra, Geometric Algebra and Applications 7.5 credits

Cliffordalgebra, geometrisk algebra och tillämpningar

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FSF3608 valid from Autumn 2015

Grading scale

Education cycle

Third cycle

Specific prerequisites

The course requires basic knowledge of several-variable calculus (preferably a solid background such as SF2713 Foundations of Analysis) and linear algebra and geometry. A basic course in abstract algebra (such as SF2719 Groups and Rings) is also recommended. Mathematical maturity (as expected on Ph.D. level) is assumed.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completing this course the student should:

- Have a good understanding of the basic theory of Clifford algebras and the associated geometric algebras, as well as their most important applications (to linear spaces and functions, orthogonal groups, spinors and multilinear analysis).
- Be able to apply the formalism and tools of Clifford algebra to various problems in geometry (discrete and continuous), as well as to a chosen specialization topic.
- Be able to independently read, understand and present advanced mathematics.
- Be able to discuss and synthesize mathematics.

Course contents

Introduktion och översikt

Foundations:

- Tensor construction
- Combinatorial / set theoretic construction
- Algebraic operations
- Standard examples (plane, space, quaternions)

Main tools:

- Vector space geometry
- Linear functions, outermorphisms
- Classification over R and C
- Representation theory
- Pin and Spin groups, bivector Lie algebra, spinors
- Clifford analysis in R^n (Dirac operator, vector analysis)

Other applications (depending on the interests of the participants):

- Monogenic functions, Clifford-valued measures and integration, Cauchy's integral formula
- Projective and conformal geometry
- Various applications in physics (classical mechanics, electromagnetism, special relativity / Minkowski space, quantum mechanics)
- Applications in combinatorics, discrete geometry
- Division algebras, octonions
- Embedded differential geometry

Disposition

Lectures and seminars

Course literature

Lecture notes will be made available to the course participants (see the web page, and http://www.arxiv.org/abs/0907.5356 for a less current version).

Optional recommended literature:
Delanghe, Sommen, Soucek - Clifford algebra and spinor-valued functions
Doran, Lasenby - Geometric algebra for physicists
Hestenes, Sobczyk - Clifford algebra to geometric calculus
Lawson, Michelsohn - Spin geometry (First chapter)
Lounesto - Clifford algebras and spinors
Riesz - Clifford numbers and spinors

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Homework assignments and an oral/written presentation of a chosen specialization topic.

Other requirements for final grade

Passing the course requires successful completion of homework assignments and an oral/written presentation of a chosen specialization topic.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.