

Partial differential equations II - a functional analytic approach, 6 credits

Partiella differentialekvationer II - en funktionalanalytisk approach, 6 högskolepoäng

Course code:	FOUK029
Third-cycle subject:	Mathematics/applied mathematics
School:	UKK
Valid from:	Autumn term 2024
Established by:	Dean of the School
Decision date:	2024-06-25
Last modified:	--
Level of education:	Third cycle level

Course objective

The course aims to equip doctoral candidates with an understanding of the theory and methods in mathematical analysis, with a specific emphasis on linear partial differential equations. In particular linear elliptic and evolution equations will be studied using Sobolev spaces using a functional analytic approach.

Course content

- *Sobolev spaces*: test functions; weak derivatives; approximation-, extension-, and trace-theorems; Sobolev's imbedding theorem.
- *second order elliptic equations*: Existence and uniqueness of weak solutions, Fredholm alternative, regularity theory, Harnack's inequality, Maximum principles
- *second order evolution equations*: Existence and uniqueness of weak solutions, regularity theory, maximum principles, parabolic Harnack inequality, finite propagation speed for hyperbolic solutions
- *Semigroup theory*: Elementary properties, generators, contraction semigroups, application of semigroup theory.

Intended learning outcomes

After passing the course the doctoral student should be able to

1. Apply reasoning and techniques used in theorem and their proofs to solve a given selection of problems.
2. Prove and apply a given selection of the course's key theorems.

3. Demonstrate understanding by being able to combine the use of concepts, theorems, and experiences from examples, as well as being able to identify analogies and generalize within the field.

The intended qualitative targets in relation to the Higher Education Ordinance, appendix 2.

Knowledge and understanding

For the Degree of Doctor, the doctoral student shall demonstrate:

- A1: broad knowledge and systematic understanding of the research field as well as advanced and up-to-date specialised knowledge in a limited area of this field, and
- A2: familiarity with research methodology in general and the methods of the specific field of research in particular.

Competence and skills

For the Degree of Doctor, the doctoral student shall demonstrate:

- B1: the capacity for scholarly analysis and synthesis as well as to review and assess new and complex phenomena, issues, and situations autonomously and critically,
- B2: the ability to identify and formulate issues with scholarly precision critically, autonomously, and creatively, and to plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work,
- B4: the ability in both national and international contexts to present and discuss research and research findings authoritatively in speech and writing and in dialogue with the academic community and society in general.

Teaching formats

Lectures and seminars.

Examination

SEM1, Seminar, 2 credits, oral performance of selected theoretical section, grades Fail (U) or Pass (G).

MUN1, Oral examination, 2 credits, oral presentation regarding learning outcome 1–3, grades Fail (U) or Pass (G).

INL1, Written assignment, 2 credits, assignment regarding learning outcome 1–3, grades Fail (U) or Pass (G).

Grade

Grade scale U-G.

Requirements

To participate in the course and the examinations included in the course, the applicant must be admitted to doctoral studies.

Selection criteria

1. Doctoral students in mathematics/applied mathematics
2. Doctoral students at Mälardalen University
3. Doctoral students at other universities in Sweden.