



The Faculty of Health, Science and Technology
Mathematics

Course Syllabus

Fundamentals of analysis

Course Code: 7MAT005
Course Title: Fundamentals of analysis
Fundamentals of analysis
Subject: Mathematics
Credits: 7.5 ECTS credits
Degree Level: Third cycle (doctoral)

Course Approval

The syllabus was approved by the Faculty of Health, Science and Technology, 28 September 2022, and is valid from the autumn semester 2022 at Karlstad University.

Language of Instruction:

Swedish or English

Prerequisites

Admission to a doctoral programme in mathematics or at least a Degree of Master (60 ECTS credits) in mathematics (or equivalent). The course is primarily aimed at doctoral students in mathematics education.

Learning Outcomes

Upon completion of the course, the doctoral student shall be able to:

- define a selection of terms relevant to the course (convergence, limit, continuity, derivative, the Riemann integral)
- formulate and prove a selection of theorems relevant to the course (nested intervals theorem, monotone convergence theorem, Bolzano–Weierstrass theorem, intermediate value theorem, extreme values theorem, mean value theorem, fundamental theorem of calculus)
- explain how basic properties of real numbers (in particular the supremum axiom) serve as a foundation for mathematical analysis

- use the abovementioned terms and theorems alongside methods and techniques introduced during the course (such as direct and indirect proof and proof by induction) to solve problems in mathematical analysis

Course Content

- Fundamental mathematical logic
- Set theory, sets of numbers
- The concept of function, elementary functions
- Direct and indirect proof, proof by contradiction
- Sequences and recursion, proof by induction
- Supremum and infimum, the supremum axiom
- Convergence of sequences
- Limits and continuity of functions
- Properties of continuous functions
- Derivative and differentiability
- Properties of differentiable functions
- The Riemann integral, the fundamental theorem of calculus

Reading List

See separate document.

Examination

Assessment is based on written assignments and oral examination.

Grades

One of the grades Pass (G) or Fail (U) is awarded in the examination of the course.

Quality Assurance

The course convenor has a duty to encourage a continuous dialogue on learning processes and goal fulfilment. A written evaluation is carried out at the conclusion of the course combined with a joint student-teacher discussion of all aspects commented on. The result of the evaluation is collated and made available in accordance with The Higher Education Ordinance, Chapter 1, § 14.

Course Certificate

Course certificate is issued at the request of the doctoral student.

Goal Matrix

The course contributes to partial fulfilment of the goals marked with an X below.

Doctoral			Licentiate		
Knowledge and understanding			Knowledge and understanding		
1a	Broad knowledge and systematic understanding of the research field	X	1a	demonstrate knowledge and understanding of the research field	X
1b	Advanced and up-to-date specialised knowledge in a limited area of this field		1b	Current specialist knowledge in a limited area of this field	
1c	Familiarity with research methodology in general and the methods of the specific field of research in particular		1c	Specialised knowledge of research methodology in general and the methods of the specific field of research in particular	
Competence and skills			Competence and skills		
2a	Capacity for scholarly analysis and synthesis as well as	X	2a	demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively	X
2b	to review and assess new and complex phenomena, issues and situations autonomously and critically		2b	plan and use appropriate methods to undertake a limited piece of research and other qualified tasks within predetermined time frames in order to contribute to the formation of knowledge	
3a	demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to		2c	as well as to evaluate this work,	
3b	plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work		3a	demonstrate the ability in both national and international contexts to present and discuss research and research findings in speech and writing and in dialogue with the academic community and	
4	demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research		3b	society in general	
5a	demonstrate 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		4	demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity.	

5b	society in general			
6	demonstrate the ability to identify the need for further knowledge and			
7	demonstrate the capacity to contribute to social development and support the learning of others both through research and education and in some other qualified professional capacity			
Judgement and approach			Judgement and approach	
8a	Demonstrate intellectual autonomy and disciplinary rectitude as well as		5	demonstrate the ability to make assessments of ethical aspects of his or her own research
8b	the ability to make assessments of research ethics, and		6	demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used
9	demonstrate specialised insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used.		7	demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning.