Faculty of Science

NUMN19, Numerical Analysis: Numerical Approximation, 7.5 credits

Numerisk analys: Numerisk approximation, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus is an old version, approved by Study programmes board, Faculty of Science on 2017-06-26 and was last revised on 2020-05-26. . The revised syllabus applied from 2020-05-26. , spring semester 2021.

General Information

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

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Mathematics	A1N, Second cycle, has only first-cycle course/s as entry requirements
Computational Science	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The overall goal of the course is to provide an introduction to classical results and numerical algorithms within approximation theory and prepare students for further studies in mathematics and computational oriented subjects. The purpose is further to develop the students' ability to solve problems, communicate mathematical reasoning, assess mathematical algorithms and translate them into effective code.

Knowledge and understanding

On completion of the course, the student shall be able to:

- motivate and exemplify the need for approximations of functions, both from the theoretical and the computational point of view,
- describe how to find good approximations with respect to different norms, in

particular the 1-, 2- and supremum-norms, and give an account of the difficulties in each of these cases,
- give an account of the relation between the topology of the approximation space and the existence and uniqueness of best approximations,
- formulate the main theorems of approximation theory, especially the characterisation theorems and the Weierstrass theorem, and outline their proofs.

Competence and skills

On completion of the course, the student shall be able to:

- identify the relevant approximation algorithm for a given situation, and write a computer program which implements it,
- present solutions and numerical results for problems such as the above ones in written and oral form,
- with adequate terminology, in a logical and well-structured manner, explain the design of the numerical methods and algorithms included in the course.

Judgement and approach

On completion of the course, the student shall be able to:

- argue for the importance of approximation theory as a tool in mathematics, computational technology and related subjects.

Course content

The course treats:

- *The approximation problem:* Norms, approximation spaces, the Weierstrass theorem.
- *Theory of best approximation in Euclidean spaces:* Existence, uniqueness, characterisation theorems, duals.
- *Construction of best approximations:* Orthogonality, Chebyshev polynomials, Haar spaces, the exchange algorithm.

Course design

The teaching consists of lectures and weekly theoretical and practical assignments.

Assessment

The examination consists of an oral examination and oral presentations of the practical and theoretical assignments.

Students who fail the regular examination are offered a re-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 entire course it is required to pass the oral examination and the oral presentation of the assignments. Grading scale on the oral presentation of the assignments is Fail and Pass, and for the oral examination the grading scale is Fail, Pass and Pass with distinction. To obtain the grade Pass with distinction, it is required in addition that the student shows a good understanding of the theoretical foundations of the approximation theory and is able to present the main ideas of the proofs of selected theorems.

Entry requirements

For admission to the course, 90 credits including knowledge equivalent to the courses MATB21 Analysis in Several Variables 1, 7.5 credits, MATB22 Linear Algebra 2, 7.5 credits, MATB23 Analysis in Several Variables 2, 7.5 credits, NUMA01 Computational Programming with Python, 7.5 credits, and NUMA41 Numerical Analysis, basic course, 7.5 credits, are required.

Further information

The course may not be included in a higher education qualification together with NUMA12 Numerical Approximation, 7.5 credits.

Subcourses in NUMN19, Numerical Analysis: Numerical Approximation

Applies from V18

1701 Assignments, 0,0 hp
Grading scale: Fail, Pass
1702 Oral Examination, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction