Faculty of Science

MATP32, Mathematics: Harmonic Analysis, 7.5 credits

Matematik: Harmonisk analys, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2019-12-04 to be valid from 2019-12-04, autumn semester 2020.

General Information

The course is an elective course for second-cycle studies for a Master of Science degree 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 main goal of the course is to introduce students in the principles and techniques of modern harmonic analysis, and to enable them to apply these techniques to a wide range of mathematical problems.

Knowledge and understanding

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

- analyse a range of mathematical problems using methods from harmonic analysis,
- give examples of important applications of the methods of harmonic analysis both within and outside mathematics,
- give a detailed account of the theory behind the methods introduced in the course,
- give an account of research problems in the subject and relate it to relevant problems within a project.

Competence and skills
After completing the course, the student should be able to:

- critically and systematically integrate knowledge from different areas of mathematics to analyse and solve complex problems using the methods of harmonic analysis,
- independently and creatively identify, formulate and solve relevant problems,
- plan and execute qualified tasks within a given time frame.

Judgement and approach
After completing the course, the student should be able to:

- argue for the important role of the methods of harmonic analysis in different areas of research in mathematics, physics and data science,
- give constructive criticism of other students' written and oral presentations,
- identify her/his own need of further knowledge and take responsibility for knowledge development.

Course content

The course treats the maximal function, the space BMO (the space of functions of bounded mean oscillation) and the Carleson embedding theorem, Muckenhoupt weights, fundamental operators of harmonic analysis such as singular integral operators (in particular the Hilbert transform) and the square function. The course gives an introduction to modern discretisation techniques of harmonic analysis, such as wavelets (in particular the Haar wavelet) and sparse domination. Examples of applications in other areas of mathematics, such as partial differential equations, and outside mathematics are included.

Course design

Teaching consists of lectures and seminars. The seminars are devoted to problem solving and presentations of relevant results. Compulsory written assignments and a project are included in the course. The project is presented through a written project report and orally at a seminar.

Assessment

The examination consists of written assignments during the course, a written project report and an oral project presentation towards the end of the course. In addition, written feedback on other students' project reports is included.

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 obtain at least 50% of the points for the homework assignments and at least 50% of the points for the project presentation and the project report. In addition, it is required that the student gives constructive criticism of other students' project reports.

To obtain the grade Pass with distinction, it is required to obtain at least 75% of the total maximum number of points for the homework assignments, project presentation and the project report. The maximum numbers of points for the assignments, the written report and the oral presentation are weighted two to two to one.

Entry requirements

For admission to the course, English B / 6 is required as well as at least 90 credits in mathematics. In addition it is required that the student has taken the courses MATB24 Linear Analysis, 7.5 credits and MATM19 Integration Theory, 7.5 credits, or has comparable knowledge. The courses MATM18 Fourier Analysis, 7.5 credits and MATM12 Analytic Functions, 15 credits, are recommended, but not compulsory.

Subcourses in MATP32, Mathematics: Harmonic Analysis

Applies from H20

2001 Assignments, 3,0 hp
Grading scale: Fail, Pass, Pass with distinction
2002 Project, 4,5 hp
Grading scale: Fail, Pass, Pass with distinction