Faculty of Science

MATM39, Mathematics: Integration Theory, 7.5 credits
Matematik: Integrationsteori, 7,5 högskolepoäng
Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2020-05-17 to be valid from 2020-05-17, spring semester 2021.

General Information

The course is an elective course for second-cycle studies for a degree of Master of Science (120 credits) 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

Learning outcomes

The main goal of the course is to give a presentation of modern integration theory based on the general theory of measures. The students will aquire a powerful and general machinery applicable to important problems in analysis as well as in other areas of mathematics, especially probability theory.
This includes the general notion of a measure defined on a sigma-algebra, construction of measures with help of outer measures, in particular the Lebesgue measure in R^d. These concepts are then used to define the integral of a measurable function with respect to a given measure and study its properties. The focus is on convergence theorems, that is, interchanging limits and integrals, as well as multiple integrals which appear as integrals against measures on product spaces.

Knowledge and understanding

After completing the course the student should be able to:

- give a detailed account of the concepts, theorems and methods within integration theory that are treated in the course,
- identify the main theorems of the course, describe the main ideas and carry out the steps in their proofs,
- give examples of non-trivial situations where these theorems apply,
- give a detailed account of the relation between the Riemann and Lebesgue integral of a function defined on a compact interval.

Competence and skills

After completing the course the student should be able to:

- integrate knowledge from the different parts of the course in connection with problem solving,
- identify problems that can be solved by methods that are part of the course and solve these using appropriate solution methods,
- explain the solution to related mathematical problems, in speech and in writing, logically coherent and with adequate terminology.

Judgement and approach

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

- identify situations where the methods of integration theory apply, for example in other areas such as probability theory, partial differential equations, function spaces.

Course content

The course treats the definition and fundamental properties of measures and integrals on general measurable spaces:

- definition of measures and construction with help of outer measures. The Lebesgue measure on R^d and Lebesgue-Stieltjes measures on the real line,
- measurable functions and their integrals with respect to the given measure. The Lebesgue integral on R^d and its comparison with the Riemann integral,
- the monotone and dominated convergence theorems, Fatou's lemma,
- pointwise almost everywhere convergence, convergence in measure and in mean. L^p-spaces, Hölder's and Minkowski's inequalities,
- product measures, Fubini's and Tonelli's theorems.

Course design

The teaching consists of lectures and seminars.

Assessment

The examination consists of a written examination and an oral examination at the end of the course. The oral examination may only be taken by those students who passed the written examination. Students who fail the regular written examination are offered a resit 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 course it is required to pass the written and the oral examination. In addition, the grade Pass with distinction requires that the total number of points obtained in the written and the oral examination is at least 75% of the total maximum number of points. The maximum number of points that can be obtained in the written and the oral examination are weighted three to one.

Entry requirements

For admission to the course English 6 or the equivalent, and at least 90 higher education credits in science or engineering, including at least 60 credits in mathematics, are required.

Further information

The course may not be included in a higher education qualification together with MATP14 Integration theory 7.5 credits or MATM19 Integration theory 7.5 credits.

Subcourses in MATM39, Mathematics: Integration Theory

Applies from V21

2101   Written Examination, 5,0 hp
      Grading scale: Fail, Pass
2102   Oral Examination, 2,5 hp
      Grading scale: Fail, Pass