SF1626 Calculus in Several Variables 7.5 credits

Flervariabelanalys

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for SF1626 valid from Autumn 2014

Grading scale

A, B, C, D, E, FX, F

Education cycle

First cycle

Main field of study

Mathematics, Technology

Specific prerequisites

Basic knowledge of calculus in one variable and linear algebra as presented in SF1624 Algebra and Geometry and SF1625 Calculus in One Variable.
Mandatory for first year, can not be read by other students

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

It is important that the student both UNDERSTANDS the mathematical theory and also knows how to APPLY it to concrete problems.

After completing this course with a passing grade the student should be able to

- Use, explain and apply fundamental concepts and methods of calculus of several variables, especially
  o interpret graphs of functions and level curves/level surfaces and sketch such curves and surfaces in simple cases
  o calculate partial derivatives and use the chain rule for real valued functions and vector valued functions
  o find and classify critical points
  o use Taylor's formula to approximate functions with polynomials to a desired degree of accuracy
  o use the Jacobian matrix for linear approximation
  o use the gradient to find directional derivatives and be able to explain its relation to level curves/level surfaces
  o solve certain optimization problems, including problems with constraints
  o explain how multiple integrals are defined and how they can be approximated by Riemann sums
  o evaluate certain multiple integrals by iterated integration and by change of variables, in particular by using polar, cylindrical and spherical coordinates
  o explain how integrals can be used to calculate lengths, area, volumes and other items e.g. mass and center of mass.
  o account for the definition of line integrals, surface integrals and flux integrals and evaluate simple instances using parameterization
  o account for and apply Green's theorem and the divergence theorem
  o explain the concepts of a potential and a conservative vector field and use them in calculations
- Propose models for applications that can be described by functions of several variables or vector-valued functions, discuss relevance and accuracy of such models and be aware of how mathematical software can be used in calculus of several variables.
- Read and understand mathematical texts on calculus of several variables and its applications, and communicate mathematical reasoning within this field orally as well as in writing.

For the higher grades the student should also be able to

- Explain how the Jacobian matrix can be used to decide whether a function is locally invertible.
- Apply the implicit function theorem.
- Account for and apply Stokes' theorem.
- Calculate limits of functions of several variables and decide whether a limit exists.
- Account for the concepts of limit, continuity and differentiability of functions of several variables.
- Solve problems in several steps that require more extensive computations.
- Generalize and adapt methods to fit into partly new situations.

- Solve problems that require methods and concepts from several parts of the course.
- Deduce important formulae and theorems of calculus in several variables.

Course contents

Euclidian n-space. Functions of several variables and vector-valued functions, including the following concepts: Graph, level curve, level surface. Limits and continuity, differentiability, partial derivatives, the chain rule, differentials. Tangent planes and linear approximation. Taylor's Formula. Gradient and directional derivative. Jacobian matrix and Jacobian determinant. Invertibility and implicitly defined functions. Coordinate changes. Extreme-value problems. Multiple integrals. Line integrals and Green's theorem. Flux integrals and the divergence theorem. Stokes' theorem. Applications.

Course literature

Robert A. Adams, Christopher Essex, **Calculus - A Complete Course**, 8th edition. ISBN 978-0-321-78107-9.

Examination

- TEN1 - Examination, 7.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

Written exam, possibly with the possibility of continuous examination.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.