LUNDS UNIVERSITET
Lunds Tekniska Högskola

*Course syllabus*

# Flerdimensionell analys med vektoranalys
# Calculus in Several Variables

## FMAB35, 7,5 credits, G1 (First Cycle)

**Valid for:** 2023/24
**Faculty:** Faculty of Engineering, LTH
**Decided by:** PLED F/Pi
**Date of Decision:** 2023-04-18

## General Information

**Main field:** Technology.
**Compulsory for:** F1, Pi1
**Language of instruction:** The course will be given in Swedish

## Aim

The course aims at giving a basic treatment of calculus in several variables, including three-dimensional vector analysis. Particular emphasis is put on the role which calculus in several variables plays in applications in different subjects of technology, in order to give the future engineer a good foundation for further studies in mathematics as well as other subjects. The aim is furthermore to develop the student's ability in problem solving and to assimilate mathematical text.

## Learning outcomes

*Knowledge and understanding*
For a passing grade the student must

- be able to compute with and handle elementary functions of several variables within the framework of the course, together with their derivatives and integrals, with confidence.
- be familiar with different representations of curves, surfaces and volumes in two and three dimensions, and be able to use them in computations.
- be able to carry out (specified) changes of variables in partial differential equations, and by this means to solve such equations.
- be familiar with basic theory of optimization, local as well as global, and be able to find the solution in simple cases.
- be able to demonstrate an ability to independently choose methods to evaluate double

and triple integrals, and be able to carry out the solution essentially correct.
- be able to demonstrate an ability to independently choose methods to evaluate curve and surface integrals, and be able to carry out the solution essentially correct.
- be able to formulate the important theorems of vector analysis, and be able to give exampes of physical applications.
- be able to demonstrate a good ability to carry out algebraic calculations within the context of the course.
- be able to give a general account of, and to illustrate the meaning of, such mathematical concepts in calculus in several variables that are used to construct and study mathematical models in the applications.
- be able to account for the contents of some central definitions, theorems and proofs.

*Competences and skills*
For a passing grade the student must

- in the context of problem solving, be able to demonstrate an ability to independently choose and use mathematical concepts and methods within calculus in several variables.
- in the context of problem solving be able to integrate concepts from different parts of the course.
- be able to demonstrate an ability to construct and analyse some simple mathematical models in calculus in several variables.
- be able to demonstrate an ability to explain mathematical arguments in a structured and logically clear way.
- have a basic ability to use the computer program Maple for visualisation and formula manipulation, and be able to identify some of its possibilities and limitations.

## Contents

*Part 1. Calculus in several variables*

- Generalities on functions of several variables. level curves, function surfaces, level surfaces, surfaces in parameter form, curvilinear coordinates.
- Partial derivatives. Differentiability, tangent planes, error propagation. The chain rule. Applications to partial differential equations. Gradient, directional derivative, level curves. Study of stationary points. Curves, tangents, arc length. Surfaces, normal direction, tangent plane. Functional (Jacobi) matrix and determinant, linearisation. Implicit functions.
- Optimization on compact and non-compact domains. Optimization with constraints.
- Double and triple integrals.  Iterated integration. Change of variables. Integration using level curves. Improper integrals. Applications: volume, centre of gravity.
- Computer work. Visualization and formula manipulation using Maple.

*Part 2. Vector analysis*

- Curve integrals in the plane. Green's formula with applications. Potentials and exact differentials.

- Surface integrals. Flux integrals. Divergence and rotation. Gauss and Stokes theorems. Potentials and exact differentials. The continuity equation.

## Examination details

**Grading scale:** TH - (U,3,4,5) - (Fail, Three, Four, Five)

**Assessment:** In the first subcourse a written test comprising theory and problem solving. In the second subcourse, a written test. The final grade is based on the results on the exams on the subcourses - the scores on the second parts of the exams are added. Computer work.

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.

**Parts**
**Code:** 0121. **Name:** Vector Analysis.
**Credits:** 2,5. **Grading scale:** UG. **Assessment:** Written test in the middle of the study period. Retakes in appropriate examination periods. **Contents:** See part 2 above.
**Code:** 0221. **Name:** Computer Work.
**Credits:** 0. **Grading scale:** UG.
**Code:** 0321. **Name:** Calculus in Several Variables.
**Credits:** 5. **Grading scale:** UG. **Assessment:** Written test comprising theory and problem solving. **Contents:** See part 1 above.

## Admission

**Assumed prior knowledge:** Calculus in One Variable (FMAB66 and FMAB70) and FMAB22 Linear Algebra.
**The number of participants is limited to:** No
**The course overlaps following course/s:** FMA435, FMA025, FMA430, FMAF15, FMAB30

## Reading list

- Anders Källén: Flerdimensionell analys med vektoranalys. KF Sigmatryck, 2023. Distributed by KFS Studentbokhandel.

## Contact and other information

**Course coordinator:** Studierektor Anders Holst, Studierektor@math.lth.se
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