Course syllabus

Calculus in Several Variables
Flerdimensionell analys

FMAB30, 6.0 credits, G1 (First Cycle)

Valid for: 2025/26
Faculty: Faculty of Engineering LTH
Decided by: PLED F/Pi
Date of Decision: 2025-04-10
Effective: 2025-05-05

General Information

Main field: Technology **Depth of study relative to the degree requirements:** First cycle, in-depth level of the course cannot be classified
Mandatory for: B2, BME2, BR2, D2, E1, I1, K2, L2, M1, MD1, N2, R2, V2, W2
Elective for: C4-pvs, C4-pvt, IBYA3, IBYI3, IBYV3, IDA3, IEA3
Language of instruction: The course will be given in Swedish

Aim

The course aims at giving a basic treatment of calculus in several variables. Particular emphasis is given to the role this 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 to solve problems 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 with confidence, together with their derivatives and integrals.
- 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 the 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 correctly, with correct limits for the integrations requiered for simple geometries.
- be able to demonstrate an ability to independently choose method to evaluate a curve integral, and be able to carry out the solution essentially correctly.
- 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 show capability to explain mathematical arguments in a structured and logically clear way.
- have a basic ability to use Maple for visualisation and formula manipulation, and be able to identify some of its possibilities and limitations.

Contents

- 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. Implicitly given functions.

- Optimization on compact and non-compact domains. Optimization with constraints.

- Double and triple integrals. Iterated integration. Change of variables. Improper integrals. Applications: volume, centre of gravity.

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

- Computer work. Visualisation and formula manipulation using Maple.

Examination details

Grading scale: TH - (U, 3, 4, 5) - (Fail, Three, Four, Five)
Assessment: Written test comprising theory and problem solving. 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.

Modules
Code: 0217. **Name:** Computer Work.
Credits: 0.0. **Grading scale:** UG - (U, G). **Assessment:** Correct solutions to preparatory problems and pass on carrying out the computer session in pair.
Code: 0117. **Name:** Calculus in Several Variables.
Credits: 6.0. **Grading scale:** TH - (U, 3, 4, 5). **Assessment:** Written test comprising theory and problem solving.

Admission

Assumed prior knowledge: Single variable calculus, e g one of the course chains FMAB45, FMAB50 and FMAB60 or FMAB65 and FMAB70, and linear algebra, e g one of the courses FMAA20, FMAA21 or FMAB20.
The number of participants is limited to: No
Kursen överlappar följande kurser: FMA025 FMA435 FMA430 FMAB35

Reading list

- Jonas Månsson och Patrik Nordbeck: Flerdimensionell analys. Studentlitteratur, 2013, ISBN: 9789144080833.
- Övningar i flerdimensionell analys. Studentlitteratur, 2013, ISBN: 9789144092508.

Contact

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