Course syllabus

Flerdimensionell analys med vektoranalys
Calculus in Several Variables

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

Valid for: 2020/21
Decided by: PLED F/Pi
Date of Decision: 2020-04-01

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
examples 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
- 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: 0120. Name: Calculus in Several Variables.
Credits: 5. Grading scale: TH. Assessment: Written test comprising theory and problem solving. The test is identical to the one given for the course FMAB30. Contents: See part 1 above. (Coinciding with the contents of the course FMAB30.)
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.
Credits: 0. Grading scale: UG.

Admission
Assumed prior knowledge: FMAA01 or FMAA05, Calculus in One Variable, FMAB20 Linear Algebra.
The number of participants is limited to: No
The course overlaps following course/s: FMA435, FMA025, FMA430, FMAF15, MATB15, FMAB30

Reading list

Contact and other information
Course coordinator: Studierektor Anders Holst, Studierektor@math.lth.se
Teacher: Anders Källén, anders.kallen@math.lth.se
Course administrator: Studerandeexpeditionen, expedition@math.lth.se
Course homepage: http://www.maths.lth.se/course/flerdimveknykod/