UNIVERSITY OF GOTHENBURG

DEPARTMENT OF MATHEMATICAL SCIENCES

MMG300 Multivariable Analysis, 15 credits

Flervariabelanalys, 15 högskolepoäng

First Cycle

Confirmation

This course syllabus was confirmed by Department of Mathematical Sciences on 2013-12-18 to be valid from 2014-01-01.

Field of education: Science 100%
Department: Department of Mathematical Sciences

Position in the educational system

The course is read during the second semester of the Mathematical program but can also be read as a freestanding course.
This is a course that requires previous higher education courses in mathematics as a prerequisite, but it does not count as specialisation for a Degree of Bachelor in the main field of study mathematics.

The course can be part of the following programmes: 1) Bachelor's Programme in Mathematics (N1MAT) and 2) No translation available (NMDSM)

Main field of studies	*Specialization*
Mathematics	G1F, First Cycle, has less than 60 credits in first-cycle course/s as entry requirements

Entry requirements

In addition to general entry requirements, knowledge equivalent to the course MMG200 Mathematics 1 is required.

Learning outcomes

After having completed Part 1, the student will be able to

- formulate and understand the meaning of definitions and theorems and prove certain theorems
- handle limits and continuity in R^n
- show familiarity with fundamental topological properties of R^n such as completeness and the Bolzano-Weierstrass theorem
- judge whether a set is open/closed/compact in R^n by means of the definitions and/or the mapping properties of continuous functions
- sketch level curves of functions of two variables and simple level surfaces of functions of three variables
- calculate partial derivatives and gradients and understand the geometric importance of the gradient
- construct tangent planes of a surface given by an equation in three variables
- transform a partial differential equation by means of a given substitution of variables and in simple cases also decide the solution
- find local extrema and saddle points for functions of two and three variables
- find extreme values of functions of two and three variables on compact sets and simple non-compact sets

After completing Part 2, the student will furthermore be able to

- calculate double and triple integrals over bounded and unbounded sets, where appropriate by means of appropriate substitution of variables
- calculate line and surface integrals of vector fields by means of parametrizations
- calculate line and surface integrals by means of Green's formula and Gauss' and Stoke's theorems
- decide whether a field in two or three dimensions is conservative and if so, find a potential
- decide whether a series converges, absolutely or conditionally, by means of appropriate convergence criteria
- determine whether a function series is uniformly convergent
- develop a function in a power series by means of known maclaurin series
- decide the domain of convergence of a power series
- use theorems about termwise integration and derivation to decide the sum of certain power series.

On completion of the course, the student will also be able to

- plan, structure and present mathematical solutions/proofs within the scope of a short blackboard presentation, characterized by good presentation technique and mathematical clarity that shows understanding.

Course content

The course is divided into two modules: Multivariable analysis part 1 and multivariable analysis part 2, which are 7.5 credits each. Furthermore, a component about mathematical communication is included.

Multivariable analysis part 1

Basic topology in R^n: limits, Cauchy sequences, open and closed sets, compact sets, pointwise and uniform continuity.

Differential calculus in R^n: partial derivatives, differentiability, gradient, directional derivative, level curves and level surfaces, parametrized curves and surfaces, tangent planes, Taylor's formula, local and global extreme values, Lagrange multipliers, the inverse and implicit function theorems (without proof), differentiation under the integral sign.

Multivariable analysis part 2

Convergence criteria for point sequences and series, function sequences, power series, exchanging the order of limits.
Riemann integration in R^n, volume calculations, line and surface integrals, potentials, closed and exact differential forms and the common forms of Stoke's theorem in R^2 and R^3.

Mathematical communication

Presentation techniques, especially blackboard presentations of mathematical solutions/proof.

Form of teaching

Attendance at teaching and supervision in presentation technique is required.

Language of instruction: Swedish

Assessment

The section on mathematical communication is assessed via blackboard presentations.

There will be a written examination at the end of each module. During the course, there may be optional assignments that give bonus points on the exam. Examples of such components are tests, written assignments, laboratory sessions or project work. Information for the current course instance is given via the course homepage.

A student who has not passed the regular examination is offered additional examinations. A student has the right to a change of examiner after failing twice on the same course, if it is practically possible. A request for change of examiner should be written and sent to the department.

Grades

The grading scale comprises: Fail (U), Pass (G), Pass with Distinction (VG).

To pass the course, a pass on both modules and on mathematical communcation is required.

For grade Pass with distinction in the whole course, it is required furthermore that the sum of the exam results for part 1 and part 2 amount to at least the sum of the exam results that are needed for Pass with distinction on each respective module.

A student who has a right to obtain grades with the ECTS scale should inform the course coordinator no later than a week after start of the course. For a student without such agreement, no ECTS grades will be given; instead the study administration will make a standardised so-called ECTS translation according to the vice-chancellor's established model.

Course evaluation

Course evaluation is done with a questionnaire and conversation with student representatives.

Additional information

Earlier versions, i.e. current up to 31/12/2013, of the course syllabus of MMG300 are not in Gubas syllabus database. The course syllabus of MMG300 was originally established 01/12/2007, when it replaced MAN030.