Linnæus University

Jnr: UGA 2013/1251-3.1.2

Course syllabus

Faculty of Technology
Department of Mathematical Education

1MAÄ01 Matematik I – inriktning mot arbete i årskurs 7-9, 30 högskolepoäng

Mathematics I – for lower secondary school teachers, 30 credits

Main field of study
Mathematics

Subject Group
Mathematics

Level of classification
First Level

Progression
G1F

Date of Ratification
Approved 2011-06-10
Revised 2013-06-14 by Faculty of Technology. Objectives, content and literature lists are revised.
The course syllabus is valid from autumn semester 2013

Prerequisites
General entry requirements and English B, Mathematics D, Civics A. (Field-specific entry requirements 6c. Specific entry requirements: Mathematics D)

Objectives

Common objectives:

- discern and describe basic characteristics of the teaching profession in relation to the subject matter and subject didactics
- identify and define subject didactic issues related to the activities that the education prepares for.

Otherwise the expected learning outcomes are valid for each module.

Module 1 Basic mathematics
After completing this module students will be able to:

- perform calculations in different numbers areas, in terms of rational and irrational numbers
- solving basic equations and inequalities containing rational expressions
- solve problems in set theory, number theory and combinatorics
- describe the definitions and sketch graphs of elementary functions
- perform basic calculations with complex numbers and solving complex polynomial

equations
- describe the definitions of and deduce the relationship between key concepts of the course and be able to use these relationships when solving problems
- interpret, communicate and argue with representational forms of mathematics.

Module 2 Geometry
After completing this module students will be able to:

- describe, in a broad sense, the structure of Euclid´s Elements and of axiomatic systems in general
- solve problems of geometry concerning triangles and circles
- give an account of the interplay between geometry and algebra
- know the basics of projective and hyperbolic geometry and be able to solve some problems in these areas
- derive the symmetry groups for plane figures
- give an account of the three classic geometric "unsolvable" problems
- compare different approaches to geometric problems
- give an account of the fractal concept

Module 3 Vector Geometry
After completing this module students will be able to:

- perform calculations with matrices and vectors and use these to describe and interpret the geometric processes
- perform calculations with dot product, cross product, volume product (determinants) and understand the geometric significance of these concepts
- deduce equations of lines and planes on the parameter form and normal form and give geometric interpretations
- calculate angles and distances between points, lines and planes
- explain the concept of linear transformation and its matrix representation and be able to calculate matrices for reflection-, projection-, and rotation operators and matrices of others linear transformations
- compute and interpret the eigenvalues and eigenvectors
- describe the definitions of and deduce relationships between key concepts in the course and be able to use these relationships when solving problems in Vector Geometry
- interpret, communicate and argue with representational forms of mathematics from didactic starting points.

Module 4 Mathematics Education for lower secondary and upper secondary school I
After completing this module students will be able to:

- show in-depth subject knowledge in mathematics relating to upper and lower secondary school and the prerequisites in mathematics needed to mutual understanding
- use school and Mathematics written policy on the development of mathematics teaching content
- describe the mathematical abilities and skills relating to conceptualization, representation, problem solving, communication and reasoning in relation to the mathematics content
- identify the role of language in mathematics, especially regarding conceptualization.

Content
The course begins with a deepening on their own mathematics knowledge.
During the introductory courses students meet classical mathematics, while they are

collecting the math example with relevance to mathematics education in upper secondary school. These examples are collected in an education portfolio, which is followed up in the introductory mathematics education course in Mathematics II. During the course the students conduct field studies in lower and upper secondary school.
These field studies intends to give students an insight into the position of Mathematics in lower and upper secondary schools and the teaching profession practice.

Module 1. Basic mathematics. 7.5 credits
Course Content

- Introductory to the Education portfolio and a didactics perspective in mathematics
- Numbers, logic, set theory
- Algebraic expressions, equations and inequalities, functions, elementary functions
- Integers, divisors, prime numbers, division algorithm, diophantine equations
- Induction
- Permutations, combinations, binomial theorem
- Complex numbers, complex plane, de Moivre formula, complex quadratic equations, factor theorem, binomial equations

Module 2. Geometry. 7.5 credits
Course Content

- Measuring of lengths, areas and volumes
- Euclid´s Element. Axiomatic systems
- Theorems about triangles and circles
- Constructions with ruler and compasses
- Problem solving
- Geometry and algebra – an interplay. Symmetry groups of plane figures
- Conic Sections
- Basics of projective geometry, hyperbolic geometry and fractal geometry
- Three classical ”unsolvable” geometric construction problems; something about number fields.

Module 3. Vector Geometry. 7.5 credits
Course Content

- Systems of linear equations, Gauss elimination
- Matrices, vectors, basis and change of basis, dot product, cross product, determinants
- Lines and planes, angle and distance calculations
- Linear transformations, matrix of a linear transformation, the composition of linear transformations, diagonalization, soemthing about higher order determinants

Module 4 Mathematics Education for lower secondary and upper secondary school I, 7.5 credits

The course begins with a critical discussion around the examples in the Education portfolio that students bring with them from the introductory math courses.
Examples have been selected based on relevance to the national curriculum and syllabi and are discussed in relation to the theoretical framework of abilities / competencies as the basis for syllabus.
The student's math skills in arithmetic, geometry, algebra, functions, probability and statistics relating to mathematics in lower secondary school (classes 7-9) are deepened and problematized from different didactic perspective.
Mathematics subject nature and historical development are highlighted in a comprehensive, school-oriented perspective.

Mathematical abilities and competencies are treated from a theoretical perspective and then connected to mathematics content and the whole illustrated by orientation around ways and working forms to support concept development and to highlight different strategies for solving problems with a particular focus on the role of language and variety of forms of representation.
Students will solve and construct their own data which are then analyzed with regard to the purpose, content, mathematical abilities and developable solution strategies.

Type of Instruction

Teaching consists of lectures, group exercises and mandatory seminars. Part of the program may be networked.

Examination

The course is assessed with the grades Fail (U), Pass (G) or Pass with Distinction (VG).
The course is examined through active participation in seminars, methodology sessions and presentations, as well through oral and written presentations of individual and group assignments, and through written examination / exam. A part of the examination consists of practical elements (field studies) that the student implements and presents.

On request, students may have their credits translated to ECTS-marks. Such a request must be sent to the examiner before the grading process starts.

Course Evaluation

After completing the course, is a course evaluation compiled and written feedback to the students. The statement recognized for the current institutional bodies and for the relevant Programme Board, and filed by the course coordinator department.

Required Reading and Additional Study Material

Required Reading

Module 1

Hellström Lennart, Johansson Per-Gunnar, Morander Staffan, Tengstrand Anders. Elementär algebra, Studentlitteratur, latest edition.

Ekstig Kerstin, Hellström Lennart, Sollervall Håkan.
Matematik Startbok, Studentlitteratur, latest edition.

Didactic literature
Hansen Hans Christian, Skott Jeppe, Jess Kristine, Schou John, Matematik för lärare Ypsilon band 1, Gleerups förlag, latest edition.

Module 2

Anders Tengstrand. *Åtta kapitel om geometri*. Studentlitteratur, 2005. 240 (311) pages.

Didactic literature
Hansen Hans Christian, Skott Jeppe, Jess Kristine, Schou John, Matematik för lärare Ypsilon band 1, Gleerups förlag, latest edition.

Module 3

Tengstrand Anders. Linjär algebra med vektorgeometri, Studentlitteratur, latest edition.

Didactic literature
Hansen Hans Christian, Skott Jeppe, Jess Kristine, Schou John, Matematik för lärare Ypsilon band 1, Gleerups förlag, latest edition.

Module 4

Andersson, Andreas, Begreppskartor - ett verktyg för bättre förståelse, Nämnaren 2/2002, www.ncm.gu.se – sök under Artikelregister. Pages 3. 4/2008. www.ncm.gu.se Pages 5.

Bergsten, Christer, Häggström, Johan & Lindberg, Lisbeth (1997). Algebra för alla. Nämnaren Tema, NCM. ISBN 91-88450-08-2

Emanuelsson, Göran, Wallby, Karin, Johansson, Bengt & Ryding, Ronnie (2000). Matematik – ett kommunikationsämne. Nämnaren Tema, NCM. Göteborgs universitet, 1996. Pages 150.ISBN 91-88450-06-6

Grevholm, Barbro, Kognitiva verktyg för lärande i matematiktankekartor och begreppskartor, (Tangenten 1/2005).
www.caspar.no/tangenten/innhald051.html-pages 8. Latest edition.

Grevholm Barbro (red.) (2001). Matematikdidaktik – ett nordiskt perspektiv. Lund: Studentlitteratur. (app.150 pages). Latest edition.

Hansen, Hans Christian, Skott, Jeppe & Jess, Kristine. (2009). Matematik för lärare Ypsilon band 1, Gleerups förlag.
ISBN13:9789140668134

Johnsen Høines, Marit (2000). Matematik som språk, verksamhetsteoretiska perspektiv. Malmö: Liber. ISBN 91-47-04670-8. (app. 100 pages)ISBN: 9789147046706

Myndigheten för skolutveckling, Mer än matematik, Liber distribution, 2008,ISBN 978-91-85589-46-3

National Research Council (2001). Adding it up: Helping Children learn mathematics. In Jeremy Kilpatrick, Jane Swafford, & Bradford Findell (Eds.). Mathematics Learning Study Committee, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press. (app. 100 pages), ISBN13: 9780309069953

Niss, Mogens (2003). Mathematical competencies and the learning of mathematics: the Danish KOM project. Proceedings of the 3rd Mediterranean Conference on Mathematical Education - Athens, Hellas 3-4-5 January 2003, 116-124.

Niss, Mogens & Højgaard Jensen, Tomas (Red.) (2002). Kompetencer og matematikloering. Ideer og inspiration til udvikling af matematikundervisning i Danmark. Uddannelsesstyrelsens temahoefteserie nr. 18-2002. Undervisningsministeriet 2002. (app. 70 pages)

Schoenfeld Allan. (1992). Learning to think mathematiucally: problem solving, metacognition, and sense making in mathematics. I: Grouws Douglas(ed.) Handbook of research on mathematics teaching and learning (p. 334-370). New York: Macmillan. ISBN 13 9780029223819

Sollervall Håkan, Tal och de fyra räknesätten, Studentlitteratur, 2007. Pages 172 (172), ISBN 9789144045276

Skolverket. Kursplan och betygskriterier för ämnet matematik. Stockholm: Skolverket. www.skolverket.se/sb/d/165/a/8906

Materials to be provided by the department, approx. 200 pages.