Board of Teacher Education
Mathematics

Syllabus

Mathematics and Mathematics Teaching II

Course Code:	MAGL12
Course Title:	Mathematics and Mathematics Teaching II *Matematik II med didaktisk inriktning*
Credits:	30
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has only upper-secondary level entry requirements (G1N)

Major Field of Study:

Course Approval
The syllabus was approved by the Board of Teacher Education 2016-08-30, and is valid from the Spring semester 2017 at Karlstad University.

Prerequisites
MAGL11 with at least 10 ECTS cr completed, or documented equivalent knowledge acquired through courses previously part of the teacher education program

Learning Outcomes
The aim of the course is that students develop good and relevant knowledge of mathematics and mathematics education. Students are expected to develop an attitude to mathematics based on understanding so that the basic conditions for continued learning in the subject are created and for varied teaching that will develop pupils' mathematical understanding and creativity.

The course comprises four modules:

Module 1 Linear algebra, 7.5 ECTS cr

Upon completion of the module, students should be able to:
1. formulate and explain definitions and theorems in linear algebra and apply them in calculations and problem solving, and prove a selection of the theorems treated in the module,
2. combine knowledge of concepts, theorems and experiences from examples, identify analogies and make generalisations,
3. compute scalar products, determine orthonormal bases for linear spaces, perform changes of basis and determine coordinates in different bases, and determine and use matrices for linear transformations,
4. determine eigenvalues and eigenvectors for linear transformations and classify quadratic forms, and
5. illustrate and investigate the concepts in this area in an educationally relevant way, using mathematical software.

Module 2 Probability and statistics, 7.5 ECTS cr

Upon completion of the module, students should be able to:
1. give an account of and apply concepts and methods in descriptive statistics and give an account of common misconceptions and misinterpretations,
2. give an account of and apply concepts, methods and models in the fields of probability and basic statistical inference,
3. give an account of and problematise different ways of treating relevant components of this module in school, and
4. use digital tools to investigate and visualise the module content in an educationally relevant way with reference to school curricula.

Module 3 Modelling with ordinary differential equations, 7.5 ECTS cr

Upon completion of the module, students should be able to:
1. formulate mathematical models with ordinary differential equations and discuss the limitations of the models,
2. apply analytical methods to solve first-order linear differential equations and separable differential equations, higher order linear differential equations with constant coeffcients and system of linear differential equations with constant coeffcients,
3. perform qualitative investigations of linear and non-linear differential equations,
5. use mathematical software for ordinary differential equations and evaluate the reliability of the results, and
6. give an account of how modelling and differential equations are treated in curricula, teaching material, and teaching in upper secondary education, and discuss the educational aspects of pupils' knowledge of the subject.

Module 4 Geometry, 7.5 ECTS cr

Upon completion of the module, students should be able to:
1. explain and discuss an axiomatic-deductive system based on Euclide's Elementa and analyse geometry and the teaching of geometry in a historical perspective,
2. solve geometrical problems and compare and assess different solutions and solution methods,
3. explain and apply important geometric definitions and theorems and perform and analyse the proofs of geometric theorems,
4. perform and analyse constructions with compasses and ruler, and with mathematical software, and give an account of some classic unsolvable geometry problems,
5. use and analyse the use of dynamic geometry software, and
6. give an account of pupils' thinking in geometry and problematise different ways to treat relevant components from this module in school.

Content
Module 1 Linear algebra, 7.5 ECTS cr

Linear space and subspace. Linear dependence, basis and dimension. Coordinates and change of basis. Scalar product and normalization. Linear transformations, eigenvalues, eigenvectors and quadratic forms.

Module 2 Probability and statistics, 7.5 ECTS cr

Diagrams, measures of central tendency and dispersion, and relationships in descriptive statistics. Common misconceptions and misinterpretations, and misleading statistics. Statistics and probability in a teaching and learning perspective. Outcome, event, independence, conditioning and combinatorial correlation. Stochastic variables, distribution functions, some discrete and continuous distributions, expected value, standard deviation and variance. Probability distributions as integrals. Estimate, confidence interval and hypothesis testing. Illustration and investigation of statistical correlation with digital tools, and didactical aspects.

Module 3 Modelling with ordinary differential equations, 7.5 ECTS cr

Translate problems of change in technology, science, and social sciences into mathmatical problems that can be studied with the help of ordinary differential equations. Analytical methods for solving first order linear equations, separable equations, and higher order linear equations with constant coefficients. Eigenvalue-based analytical methods for linear systems with constant coefficients. Qualitative investigation with the help of phase-plane portraits. Euler's explicit method for solving differential equations. Numerical solutions of non-linear differential equations with the help of mathematical software. Modelling with differential equations in a school perspective.

Module 4 Geometry, 7.5 ECTS cr.

Classical Euclidean geometry and geometry problem solution. Axiomatic-deductive system. Definitions, theorems and proofs for triangle and circle geometry. Constructions with compasses and ruler, constructions with concrete material and constructions with dynamic geometry software. Analytical geometry. Outline of non-Euclidean geometries. The history of geometry, the role of geometry in school mathematics education and didactical aspects.

Reading List
See separate document.

Examination
Assessment is based on the following mandatory components:

Module 1 Linear algebra, 7.5 ECTS cr

Written exam (learning outcomes 1, 2, 3, 4)
Pair or group assignment with oral presentation to fellow students and reviewing another group's presentation (learning outcome 5)

Module 2 Probability and statistics, 7.5 ECTS cr
Written exam (learning outcomes 1, 2, 3)
Individual video recorded teaching task shown to a group of school students and followed up with a field study in the school and a written report (learning outcome 3)
Group assignment with written report (learning outcomes 3, 4)

Module 3 Modelling with Ordinary Differential Equations, 7.5 ECTS cr
Written exam (learning outcomes 1, 2, 3, 4)
Individual assignment with oral presentation to fellow students or in the form of a video recording (learning outcomes 1, 3, 5)
Group assignment with written report (learning outcomes 4, 5, 6)

Module 4 Geometry, 7.5 ECTS cr.
Written exam (learning outcomes 1, 2, 3, 4)
Individual assignment using dynamic software presented in a written report (learning outcomes 4, 5)
Pair or group assignment with written presentation of a lesson plan using digital tools, and oral presentation in the form of a lesson to fellow students, and reviewing another group's presentation (learning outcome 3, 5, 6)

Grades
One of the grades Distinction (VG), Pass (G), or Fail (U) is awarded in the examination of the course.

Quality Assurance
Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate
A course certificate will be provided upon request.

Additional information
The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.

Teacher Education: Secondary school level