



Board of Teacher Education  
Mathematics

## Syllabus

### Mathematics and Mathematics Teaching I

|                                    |   |
|------------------------------------|---|
| <b>Course Code:</b>                | MAGL11  |
| <b>Course Title:</b>               | Mathematics and Mathematics Teaching I<br><i>Matematik I med didaktisk inriktning</i> |
| <b>Credits:</b>                    | 30  |
| <b>Degree Level:</b>               | Undergraduate level   |
| <b>Progressive Specialisation:</b> | 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 2016-03-02, and is valid from the Autumn semester 2016 at Karlstad University.

#### Prerequisites

General admission requirements plus upper secondary level English 6, Social Science 1b or 1a1 + 1a2, Mathematics 4, or English B, Social science A, Mathematics D, or equivalent

#### 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 three modules.

Module 1 The basics of mathematics and problem-solving, 9 ECTS cr

Upon completion of the module, students should be able to:

1. discuss the definition of problem-solving, apply different strategies for problem-solving, and identify patterns and generalisations,
2. use and communicate the symbols and methods of set theory and logic correctly,
3. use and communicate central concepts in elementary number theory, solve linear diophantine equations, and use congruence arithmetics,
4. give an account of what characterises a good number sense and an account of the advantages and disadvantages of different arithmetic methods; written methods, mental arithmetic, and calculations using tools,
5. describe and use positional number systems and position independent number systems and give an account of some ancient cultures' number systems,
6. perform and assess mathematical reasoning and simple proofs and discuss the importance of mathematical reasoning and proofs in school, and

7. compare different methods and procedures in mathematics teaching in relation to school curricula.

#### Module 2 Basic algebra, 6 ECTS cr

Upon completion of the module, students should be able to:

1. formulate and explain definitions and theorems in basic algebra and apply them in calculations and problem-solving and prove a given selection of theorems treated in the module,
2. combine knowledge of concepts and theorems with experience of examples, identify analogies and make generalisations,
3. solve problems in basic algebra using dynamic mathematics software, and
4. give an account of and problematise different methods to treat the relevant content of this module in school.

#### Module 3 Mathematical relationships and change in one variable, 15 ECTS cr

Upon completion of the module, students should be able to:

1. formulate and explain definitions and theorems in one variable analysis and apply them in calculations and problem-solving and prove a given selection of theorems treated in the module,
2. combine knowledge of concepts and theorems with experience of examples, identify analogies and make generalisations, and model some real-world processes involving change,
3. solve problems in one variable analysis using dynamic mathematics software and digital tools as pedagogical aids in mathematics teaching,
4. give an account of and problematise different methods to treat the relevant content of this module in school, and
5. take an historical perspective on the mathematical content of the module.

### **Content**

#### Module 1 The basics of mathematics and problem-solving, 9 ECTS cr

Patterns and generalisations, arithmetic and geometric series and sums. Set theory notation set theory operations, Venn diagrams and the sets normal numbers, integers, rational numbers, real numbers and complex numbers. Basic logic with truth tables and quantifiers as implication and equivalence. Different number bases and transformations between them. Divisibility, prime numbers, the greatest common divisor, diophantine equations, congruence arithmetic. Direct proof, indirect proof, proof by contradiction and proof by induction.

Curricula and syllabi in mathematics. Teaching methods in school and analysis of teaching material. Different aspects of problem-solving and its central role in the teaching of mathematics are studied, as are different strategies and common learner reactions to problem-solving. Pupils' basic perception of numbers and the arithmetic of positive and negative integers and rational numbers as fractions and decimals. Different number systems, including those of some early cultures. Performing and assessing mathematical reasoning and proofs in school.

#### Module 2 Basic algebra, 6 ECTS cr

Vectors in the plane and space, scalar and vector products. Equations of lines and planes, distance between points, lines and planes. Complex numbers in cartesian form, polar form and exponential form. Polynomial long division, the division algorithm, the factor theorem and the fundamental theorem of algebra. Polynomial equations and binomic equations.

Matrices and matrix arithmetics, matrix transpose, systems of linear equations in matrix form linear equation, and matrix inverse. Determinants and determinant arithmetics.

Didactic treatment of algebra and equations in a school perspective. Visualisations and investigating activities using dynamic mathematics software and related teaching and learning issues.

### Module 3 Mathematical relationships and change in one variable, 15 ECTS cr

The concept of function and ways to introduce it. Function domain, function range, injectivity, surjectivity, bijectivity and invertability. Combination of functions and calculation of function inverse, The elementary functions; polynomial function, power function, exponential function, logarithm function, and corresponding equations and inequalities. Trigonometric functions and the inverse trigonometric functions, hyperbolic functions, and the corresponding equations.

Limit, continuity, derivative and derivation rules. Curve construction, extreme value problems and Taylor's formula. Primitive function, integral and integration methods and generalised integrals.

Number sequences and series, and basic convergence criteria. Applications, modelling and problem-solving using one variable analysis, also with the help of dynamic mathematics software.

The historical development of the area of mathematical analysis. Some module components are also treated with a more advanced mathematics teaching perspective. Visualisations and investigating activities using dynamic mathematics software, and related teaching and learning issues.

#### **Reading List**

See separate document.

#### **Examination**

All examination components are mandatory.

### Module 1 The basics of mathematics and problem-solving

Assessment is based on:

Written exam (learning outcomes 1, 2, 3, 4, 5, and 6)

Individual video presentation of task solving assignment (learning outcomes 2 and 3)

Individual written report on field study in a school classroom (learning outcome 7)

Group assignment with written report (learning outcome 1 and 7).

### Module 2 Basic algebra

Assessment is based on:

Written exam (learning outcomes 1 and 2)

Group assignment in the form of a pedagogical reflection on the group's own exam solutions and oral presentation (learning outcomes 1, 2, and 4)

Group assignment using dynamic software with a written report (learning outcomes 1, 2, and 3)

### Module 3 Mathematical relationships and change in one variable

Assessment is based on:

Written exam (learning outcomes 1 and 2)

Two group assignments using dynamic software with a written report (learning outcomes 1, 2, and 3)

Group assignment with written report on a lesson plan using ICT tools and an oral presentation in the form a trial lesson, including giving oral and written comments on another group's lesson plan (learning outcome 3 and 4).

Group assignment presented in writing and orally at a seminar (learning outcome 5).

#### **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 schools