Dette er en oversettelse av den fastsatte læreplanteksten. Læreplanen er fastsatt på Bokmål

Laid down as a regulation by the Norwegian Directorate for Education and Training on 27 March 2006 as delegated in a letter of 26 September 2005 from the Ministry of Education and Research pursuant to the Act of 17 July 1998 no. 61 relating to primary and secondary education (Education Act) Section 3-4 first paragraph.

Valid from 01.08.2006

Valid to 31.07.2022

Purpose

Mathematics is a subject that plays a key role in our modern civilization, as a tool to understand and function in society and as bearer of a tradition with roots in many of the world's ancient cultures. Mathematics is used to investigate the universe, systematize experience and describe and understand natural and social relations. The pleasure obtained from working with the subject has in itself been a source of inspiration for mankind's development of mathematics.

One of the main purposes of the programme subject is to acquire the mathematical competence needed to maintain and develop a hi-tech society. The programme subject's unique characteristics shall contribute to understanding the significance of mathematics in our culture and to the development of analytical and investigative skills as well as the art of reasoning. The programme subject, therefore, has a practical as well as a cultural perspective in its purpose.

The programme subject mathematics for the natural sciences gives specialization in mathematics for further education and work within natural science, medicine, technology, computer studies, economics and education. Through exercising computational skills, with and without digital aids, a basic and necessary competence for advanced mathematics is developed.

Work in the programme subject shall give an introduction to logical and analytical thinking with emphasis on mathematical reasoning and presentation, while at the same time giving the pupils training in key methods through application.

Structure

Mathematics for the natural sciences comprises two programme subjects: *Mathematics R1* and *Mathematics R2*. Mathematics R2 builds on Mathematics R1, which in turn builds on Mathematics Vg1 T.

These programme subjects have been structured into main subject areas, for which competence aims have been formulated. The main subject areas complement each other, and should be viewed in relation to one another.

Overview of the main subject areas:

Programme subject	**Main subject areas**			
Mathematics R1	Geometry	Algebra	Functions	Combinatorics and probability
Mathematics R2	Geometry	Algebra	Functions	Differential equations

Main subject areas

Mathematics R1

Geometry

The main subject area deals with the measurement, calculation and analysis of figures in the plane. Central to the main subject area are two approaches to geometry, which complement each other. The first focuses on the use of geometric loci, congruence and symmetry to solve problems by pure geometrical arguments. Geometric construction using a compass and straightedge is based on these concepts. The other focuses on the use of vectors and coordinates to convert geometrical problems to algebra. In addition, the main subject area deals with the development of formal logical arguments and proofs in a geometrical context.

Algebra

The main subject area deals with the fundamental language of symbols in mathematics. Calculation, manipulation and argumentation using mathematical symbols are therefore absolutely central to the main subject area. Argumentation involves the use of different types of proof and logical relations. In addition, the main subject area covers key concepts such as polynomials, polynomial division and rational, logarithmic and exponential expressions.

Functions

The main subject area deals with the analysis of the dependence between two quantities. It focuses on relations between quantities from algebra, geometry or practical areas, which are analyzed by functions and graphs. The main subject area also deals with the relation between a function and its derivative. It covers polynomial functions, power functions, rational functions, logarithmic functions, exponential functions and combinations of these. Core concepts in the main subject area are boundedness, continuity and differentiability.

Combinatorics and probability

The main subject area deals with systematic counting methods that form the basis for calculating probability. It also focuses on the fundamental concepts of statistical independence and conditional probability and about random and non-random selection.

Mathematics R2

Geometry

The main subject area deals with the measurement, calculation and analysis of figures in space. It also focuses on coordinates, equations and vectors, which are used to determine figures and calculate lengths, angles, area and volume. It also includes three-dimensional vectors, scalar and vector products and parameter presentation.

Algebra

The main subject area deals with the analysis and calculation of numerical patterns, finite sums and infinite series. Basic methodologies in the main subject area are recursion and induction. It also focuses on series, convergence and proof by induction.

Functions

The main subject area deals with the application of periodic functions for modelling periodic phenomena. It also involves the derivation and integration of central functions in modelling and calculations. Central functions included in the main subject area are polynomial functions, power functions, rational functions, logarithmic functions, exponential functions, periodic functions and combinations of these.

Differential equations

The main subject area deals with applying mathematics for the analysis and calculation of dynamic phenomena. This main subject area includes standard methods for linear and separable differential equations that are applied to practical problems. The subject area also involves key concepts such as initial conditions, vector diagrams and integral curves.

Teaching hours

Teaching hours are given in 60-minute units.

Mathematics R1: 140 teaching hours per year

Mathematics R2: 140 teaching hours per year

Basic skills

Basic skills are integrated into the competence aims for this course in areas where they contribute to the development of and are part of the subject competence. In the *Mathematics for the natural sciences* programme subject, basic skills are understood as follows:

Being able to express oneself orally and in writing in Mathematics for the natural sciences involves the ability to formulate logical arguments, explain a way of thinking, and articulate findings, concepts and hypotheses, i.e. posing questions, participating in talks and discussions of mathematical situations and problems, and presenting a reasoned argument for one's own proposed solution.It includes formulating on paper mathematical proofs using correct mathematical notation and relevant logical conclusions. It also means writing mathematical symbols and expressions and setting up or drawing tables, diagrams, graphs and geometrical figures.

Being able to read in Mathematics for the natural sciences involves the ability to extract relevant mathematical information from written text, i.e. understanding mathematical symbols and expressions and logical arguments. It also means understanding and interpreting organized visual information such as tables, diagrams, graphs and geometrical figures.

Numeracy in Mathematics for the natural sciences is the most basic skill in the subject. It means confidence in choice of operation and confidence in applying various arithmetical operations without the use of digital tools. To do arithmetic means learning new operations, such as derivation and integration, i.e. making practical estimates and assessing the reasonableness of a solution.

Being able to use digital tools in Mathematics for the natural sciences involves using digital tools for comprehensive computations and visualisation. This means retrieving, processing and presenting mathematical information in electronic form. It also means evaluating the suitability, possibilities and limitations of the digital tool.

Competence aims

Geometry

The aims of the studies are to enable pupils to

- use lines and circles as geometric loci together with congruence and the inscribed angle theorem in geometrical analysis and calculations
- execute and analyze constructions defined by straight lines, triangles and circles in the plane, with and without the use of dynamic software
- derive and apply the intersection theorems for the heights, angle bisectors, perpendicular bisectors and medians in a triangle
- give an account of different proofs for Pythagoras' equation, in terms of cultural history as well as mathematics
- visualize vectors in the plane, both geometrically as arrows and analytically in co-ordinate form
- calculate and analyze lengths and angles to determine the parallelity and orthogonality by combining arithmetical rules for vectors

Algebra

The aims of the studies are to enable pupils to

- factorize polynomials with the help of zeros and polynomial division, and use this to solve equations and inequalities with polynomial and rational expressions
- transform and simplify complex rational functions and other symbolic expressions with and without the use of digital aids
- derive the basic arithmetical rules for logarithms, and use these and the power rules to simplify expressions and solve equations and inequalities
- give an account of implication and equivalence, and implement direct and contrapositive proof

Functions

The aims of the studies are to enable pupils to

- give an account of the concepts of boundedness, continuity and differentiability, and give examples of functions that are not continuous or differentiable
- use formulae for the derivative of power, exponential and logarithmic functions, and differentiate composites, differences, products, quotients and combinations of these functions
- use first derivative and second derivative to elaborate on and discuss the path of functions and interpret the derivatives in models of practical situations
- draw graphs to functions with and without digital means, and interpret the basic characteristics of a function using the graph
- find the equation for horizontal and vertical asymptotes to rational functions and draw the asymptotes
- use vector functions for a parameter presentation of curves in the plane, draw the curve and differentiate the vector function to find velocity and acceleration

Combinatorics and probability

The aims of the studies are to enable pupils to

- give an account of the concepts of statistical independence and conditional probability, and derive and apply Bayes' equation for two events
- elaborate on and discuss combinatoric problems linked to non-random selection with or without replacement and random selection without replacement, and use this to derive rules for calculating probability

Geometry

The aims of the studies are to enable pupils to

- perform calculations with three-dimensional vectors that are represented both geometrically and in co-ordinate form
- use and interpret the scalar and vector product in the calculation of distances, angles, area and volume
- use vector calculus to find equation and parameter presentations for lines, plane and spherical surfaces
- calculate longitudinals, angles and areas in bodies limited by plane and spherical surfaces

Algebra

The aims of the studies are to enable pupils to

- find and analyze recursive and explicit formulae for numerical patterns with or without digital means, and implement and present simple proofs linked to these formulae
- implement and give an account of proof by induction
- sum finite series with or without digital means, derive and use the formulae to the sum of the first n members in arithmetic and geometric series, and use this to solve practical problems
- calculate with infinite geometric series with a constant and variable quotients, determine the area of convergence for these series and present the results

Functions

The aims of the studies are to enable pupils to

- simplify and solve linear and quadratic equations in trigonometric expressions by using relations between the trigonometric functions
- derive central functions and use first and second derivatives to elaborate on and discuss such functions
- transform trigonometric expressions of the type a sin kx + b cos kx , and use these to model periodic phenomena
- give an account of the definition of a definite integral as a limit of a sum and an indefinite integral as an anti-derivative
- calculate integrals of the central functions by anti-derivation, substitution, partial fraction decomposition with linear denominators and integration by parts
- interpret the definite integral in models of practical situations and use it to compute plane areas and volumes of rotating bodies
- formulate a mathematical model with the help of central functions on the basis of observed data, process the model and elaborate on and discuss the result and method

Differential equations

The aims of the studies are to enable pupils to

- model practical situations by converting the problem to a differential equation, solving it and interpreting the result
- solve the first order linear and separable differential equations by calculation and give an account of some important areas of application
- solve homogenous second order differential equations and use Newton's second law to describe free oscillations by periodic functions
- solve differential equations and draw vector diagrams and integral curves, and interpret them using digital tools

Assessment

Provisions for final assessment:

Overall achievement grades

Programme subject	Provision
Mathematics R1	The pupils shall have an overall achievement mark.
Mathematics R2	The pupils shall have an overall achievement mark.

Examination for pupils

Programme subject	Provision
Mathematics R1	The pupils may be selected for a written or oral exam. The written exam is prepared and marked centrally. The oral exam is prepared and marked locally.
Mathematics R2	The pupils may be selected for a written or oral exam. The written exam is prepared and marked centrally. The oral exam is prepared and marked locally.

Examination for external candidates

Programme subject	Provision
Mathematics R1	The external candidates shall sit for a written exam. The written exam is prepared and marked centrally.

Mathematics R2	The external candidates shall sit for a written exam. The written exam is prepared and marked centrally.

The provisions for assessment are stipulated in the regulations of the Norwegian Education Act.