

Subject Module in Mathematics

(English version of the legal Danish subject module curriculum)

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The regulations of these subject module specifications are issued pursuant to the Curricula for the Bachelor Study Programmes in Natural Sciences, Hum-Tek, Humanities, and Social Science. The regulations of the Curriculum for the Bachelor Study Programme to which the student has been admitted are applicable unless otherwise clearly stated in the regulations of the subject module specifications.

Purpose

§1 The purpose of the subject module in mathematics is:

- To give students a broad basic knowledge of the structures and methods of the subject.
- To give students qualifications to work with mathematical models within other subject areas.

A further objective of the subject module in mathematics is to qualify students to enter a Master Programme in Mathematics or other related subjects.

- (2) The subject module in mathematics is one of two subject modules that form part of the bachelor studies at Roskilde University. The subject module corresponds to 35 ECTS points.

Description of competency

§2 The purpose of the subject module in mathematics is to give students the following knowledge, skills, and qualifications.

Knowledge:

- Knowledge and understanding of proofs and proving in mathematics.
- Knowledge and understanding of basic mathematical results and their scope.
- Knowledge and understanding of mathematical modeling.

Skills:

- Skills in dealing with symbolism and formalism.
- Skills in communicating in, with and about mathematics.
- Skills in revealing the leading principle/the principle idea of a proof.
- Skills in recognizing, understanding and dealing with mathematical concepts.

Qualifications:

- Qualifications to identify, describe, define, and solve mathematical problems.
- Qualifications to understand and reflect on the basis for and the characteristics of mathematical models in other subject areas.
- Qualifications to study new areas of mathematics.
- Qualifications to engage independently and professionally in collaboration with others in modeling activities in mathematics and other subjects.
- Qualifications to identify one's own needs for learning and to structure such learning in different learning environments.

Content and structure

§3 The subject module corresponds to 35 ECTS points and consists of the following elements:

- Subject module project in mathematics (15 ECTS points)
- Subject module course 1: Mathematical modeling and dynamical systems (5 ECTS points).
- Subject module course 2: Algebra (5 ECTS points).
- Subject module course 3: Mathematical analysis I – Basic theory (5 ECTS points)
- Subject module course 4: Mathematical analysis II – Advanced theory (5 ECTS points).

Recommended academic requirements

§4 The academic requirements for admission to the subject module are for students to possess knowledge, skills and qualifications corresponding to the courses “Calculus” and “Linear Algebra” offered during the basic part of the Bachelor Study in Natural Sciences.

Description of the elements of the subject module

§ 5.

Title	Subject module project in Mathematics
Type	Project.
Status	Compulsory.
ECTS	15 ECTS points.
Purpose (assessment criteria)	<p>The purpose of the project is to for students to acquire:</p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge and experience of one or more mathematical models in other subject areas. (In the following referred to as the models.) • Knowledge and understanding of the key mathematical concepts of the project and the ability to reflect on their characteristics, scope, and relevance to the project. • Capability to understand the mathematical model(s) and to reflect

	<p>on the basis, characteristics, scope, and validity of the model(s).</p> <p>Skills:</p> <ul style="list-style-type: none"> • Skills to comprehend, analyse and deal with mathematical models concerning other subject areas and the capability to discuss the validity of these. • Skills to work with and apply mathematical symbolism and the key mathematical concepts of the project and to discuss their scope. • Skills to critically analyse and assess the mathematical models in relation to scope, applicability, and relevance, and in relation to possible alternative models. • Skills to discuss the applied symbolism and central mathematical concepts, their scope and relevance. • Skills to analyse and assess the basis of and the characteristics of mathematical models applied to other subject areas. • Skills to communicate with professionals and non-professionals about mathematical models, their characteristics, applicability, and results. <p>Qualifications:</p> <ul style="list-style-type: none"> • Qualifications in mathematical modeling. • Qualifications in independently identifying and analysing mathematical models.
Overall content	<p>The project work is problem oriented and exemplary.</p> <p>The project work deals with mathematical models made to represent and describe areas outside mathematics itself. It could be analysing and assessing existing models/types of models as well as independently making and analysing a mathematical model or parts of a model.</p> <p>The project work is completed with the writing of a project report.</p>
Academic requirements	It is recommended that students have passed subject model course 1.
Language	Danish or English
Reading skills	Students are expected to be able to read texts in English at a level at least equivalent to the High School B level.
Examination	<p>The project is made by a group of 2 to 8 students, cf. Curriculum for the relevant Bachelor Study Programme. The project is assessed at an oral examination. The recommended lengths of the examination including the assessment discussion are 30 minutes per student.</p> <p>The examination is a group examination for the students who have written the project report. The basis of the examination is the project report. The examination is a conversation between the students, the supervisor(s) (the internal examiner), and the external examiner. The examination is based on the entire project report and performed in a way that allows individual assessment. Questions from the examiners can be asked not only to the project report but also to the subject area of the project module.</p>

	Each student is assessed individually and the assessment is a joint assessment of the project report and the oral presentation.
Marking	The 7-point-scale.
Assessment	External.

Subject module course 1	
Title	Mathematical modelling and dynamic systems.
Type	Course.
Fagtype	Compulsory.
ECTS	5 ECTS points.
Purpose (assessment criteria)	<p>The purpose of the course is for students to acquire:</p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge and experience of mathematical modeling and dynamical systems in general. • Knowledge and experience of exemplary mathematical models, their foundation, structure, characteristics, scope, and validity. • Knowledge of mathematical methods and theories typically applied in connection with mathematical modeling. <p>Skills:</p> <ul style="list-style-type: none"> • Skills to comprehend, analyse and deal with mathematical models and dynamical systems in general. • Skills to work with and use mathematical symbolism and key mathematical concepts. • Skills to critically analyse and assess mathematical models in relations to scope, usefulness, and relevance and to possible alternative models. • Skills to communicate with professionals and non-professionals about mathematical models and dynamical systems, their characteristics, usefulness, and results. <p>Qualifications:</p> <ul style="list-style-type: none"> • Qualifications in mathematical modeling. • Qualifications in independently identifying and analysing exemplary mathematical models and dynamical systems.
Overall content	The course deals with mathematical modeling and dynamical systems in general, including mathematical concepts and theories pertaining to the study of (ordinary as well as partial) differential equations and parameter estimation processes. The course introduces both analytical and numerical methods.
Academic requirements	None.
Language	English.
Reading skills	Students are expected to be able to read texts in English at a level at least equivalent to High School Level B.

Examination	<p>To pass the course students must meet the following requirements:</p> <p>During the course:</p> <ul style="list-style-type: none"> • approval of three individual, written tasks • approval of a written group report on a mathematical model • approval of an individual, oral presentation of a optional model. <p>After the course: an individual, oral examination. The examination is internal and the duration is 20 minutes including the assessment discussion.</p> <p>The basis of the oral examination is a portfolio consisting of the three written tasks and the written group report.</p> <p>At the examination the student draws one of the four tasks of the portfolio and makes a presentation without further preparation. The presentation is followed by questions asked by the examiners.</p>
Marking	Passed/Failed.
Assessment	Internal.
Term	Autumn.

Subject modul course 2	
Title	Algebra.
Type	Course.
Status	Compulsory.
ETCS	5 ECTS points.
Purpose (assessment criteria)	<p>The purpose of the course is for students to acquire:</p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge and experience of abstract algebra. • Knowledge and experience of proofs and reasoning in algebra. • Knowledge of the symbolism and formalism of algebra. • Knowledge of the concepts of algebra, their scope, and interrelations, and confidence with the definitions and simple characteristics of groups, rings, and fields. <p>Skills:</p> <ul style="list-style-type: none"> • Skills to read, analyse, understand, independently construct and present mathematical proofs, orally and in writing, within the conceptual framework of algebra. • Skills to use the mathematical concepts of algebra and to understand their scope and interrelations • Skills to use algebraic symbolism and formalism. • Skills to give examples of algebraic structures based on ordinary sets of numbers (N, Z, Q, R and C). • Skills to demonstrate understanding of types of questions and problems to which algebra constitutes a substantial element in

	<p>the formulation and/or solution.</p> <ul style="list-style-type: none"> • Skills to identify problems and sets of problems of which a substantial element is algebra, and skills to solve problems which are mainly algebraic. <p>Qualifications:</p> <ul style="list-style-type: none"> • Mathematical thinking competency in algebra. • Representation, symbol and formalism competencies in algebra. • Reasoning and communication competencies in algebra. • Problem tackling competency in algebra.
General content	<p>Sets with compositions. Fundamental algebraic structures (including groups, rings and fields), their characteristics and characteristic components, and their properties (for instance in relation to quotient structures). The algebraic characteristics of different number fields. Important concrete examples of algebraic structures (such as for instance symmetry groups, polynomial rings, and finite fields).</p>
Language	English.
Reading skills	Students are expected to be able to read texts in English at a level at least equivalent to High School B-level.
Academic requirements	None.
Examination	<p>The examination is a joint assessment of a written examination paper, and an oral examination. The examination is subject to external assessment.</p> <p>The examination paper is brought home. It must be written individually and handed in within 5 days.</p> <p>The oral examination is based on the written examination paper. The oral test serves first of all to prove ownership of the examination paper but also to facilitate a possible adjustment of the grade. The oral examination takes 30 minutes including the assessment discussion.</p> <p>One joint grade is given.</p>
Marking	The 7 point scale.
Assessment	External.
Term	Spring.

Subject module course 3	
Title	Mathematical analysis I – Fundamental Theory.
Type	Course.
Status	Compulsory.
ETCS	5 ECTS-point.
Purpose (assessment criteria)	<p>The purpose of the course is for students to acquire:</p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge and experience of fundamental mathematical analysis. • Knowledge and experience of proofs and reasoning in fundamental mathematical analysis. • Knowledge of the characteristics of the real numbers, including completeness, cardinality and topological properties including.

	<ul style="list-style-type: none"> • Knowledge of the symbolism and formalism of fundamental mathematical analysis. • Knowledge of the mathematical concepts of the fundamental analysis taught in the course and understanding of their scope and interrelations. <p>Skills:</p> <ul style="list-style-type: none"> • Skills to read, analyse, understand, independently construct and present mathematical proofs, orally and in writing, within the conceptual framework of the fundamental (Weierstrass) analysis. • Skills to use the mathematical concepts of the fundamental analysis and to understand their scope and interrelations. • Skills to use the symbolism and formalism of fundamental mathematical analysis. • Skills to demonstrate an understanding of types of questions and problems, the formulation and/or solutions of which substantially involve fundamental mathematical analysis. • Skills to identify problems and sets of problems substantially involving elementary mathematical analysis and skills to solve problems with and within fundamental mathematical analysis. <p>Qualifications:</p> <ul style="list-style-type: none"> • Mathematical thinking competency of the fundamental (Weierstrass) analysis. • Representing, symbol and formalism competencies of fundamental mathematical analysis. • Reasoning and communicating competencies of fundamental mathematical analysis. • Problem tackling competency of fundamental mathematical analysis.
Overall content	<p>The content of the course is first of all real analysis in one dimension. The main focus of the course is the conceptual basis, the construction of a coherent theory, and detailed arguments for the results of the theory. Among others the following topics will be dealt with: The real numbers and their properties with focus on completeness, cardinality, and their topological nature such as compactness; Weierstrass analysis, the concept of a function and a systematic introduction of continuity and differentiability.</p>
Language	English.
Reading skills	Students are expected to be able to read texts in English at a level at least equivalent to High School B level.
Academic qualifications	None.
Examination	<p>The examination is one overall assessment of a written examination paper and an oral examination. The examination is assessed by an internal examiner.</p> <p>The examination paper is brought home. It must be written individually and handed in within 5 days.</p>

	<p>The oral examination is based on the written examination paper. The oral test serves first of all to prove ownership of the written examination paper but also to facilitate a possible adjustment of the grade.</p> <p>The oral examination takes 30 minutes including the assessment discussion.</p> <p>One joint grade is given.</p>
Marking	The 7 point scale.
Assessment	Internal.
Term	Autumn.

Subject module course 4	
Title	Mathematical analysis II – Advanced Theory.
Type	Course.
Status	Compulsory.
ETCS	5 ECTS points.
Purpose (assessment criteria)	<p>The purpose of the course is for students to acquire:</p> <p>Knowledge:</p> <ul style="list-style-type: none"> • Knowledge and experience of real analysis, i.e. mathematical analysis of \mathbb{R}^n. • Knowledge and experience of mathematical thinking including proof and reasoning of real analysis. • Knowledge of the symbolism and formalism of real analysis. • Knowledge of the mathematical concepts of real analysis and understanding of their scope and interrelations. <p>Skills:</p> <ul style="list-style-type: none"> • Skills to independently read, analyse, understand, construct and present mathematical proofs, orally and in writing, within the conceptual framework of real analysis. • Skills to use the mathematical concepts pertaining to real analysis and to understand their scope and interrelations. • Skills to deal with the symbolism and formalism of real analysis. • Skills to demonstrate knowledge of types of questions and problems the formulation and/or solutions of which substantially involve fundamental mathematical analysis. • Skills to identify problems and sets of problems of which real analysis is a substantial element, and skills to solve problems composed substantially by real analysis. <p>Qualifications:</p> <ul style="list-style-type: none"> • Mathematical thinking competency of real analysis. • Representation, symbol and formalism competencies of real analysis. • Reasoning and communicating competencies of real analysis.

	<ul style="list-style-type: none"> • Problem tackling competency of real analysis.
General content	The area of the course is the mathematical analysis of \mathbb{R}^n , $n \geq 1$. The main focus of the course is the conceptual basis, the construction of a coherent theory and the detailed arguments for the results of which some will be familiar. Among others the following topics will be dealt with: Topology of \mathbb{R}^n , $n \geq 1$, continuity and differentiability of functions of several variables. Inverse function Theorem and implicit function Theorem. Furthermore, selected topics from mathematical analysis will be thought during the course.
Language	English.
Reading skills	Students are expected to be able to read texts in English at a level at least equivalent to High School B level.
Academic requirements	Students must have acquired knowledge, skills and qualifications equivalent to subject model course 3.
Examination	<p>The examination is one overall assessment of a written examination paper and an oral examination. The examination is assessed by an external examiner.</p> <p>The examination paper is brought home. It must be written individually and handed in within 5 days.</p> <p>The oral examination is based on the written examination paper. The oral test serves first of all to prove ownership of the written examination paper but also to facilitate a possible adjustment of the grade.</p> <p>The oral examination takes 30 minutes including the assessment discussion.</p> <p>One joint grade is given.</p>
Marking	The 7point scale.
Assessment	External.
Term	Spring.

Coming into force and transitional rules

§6 The description of the subject modules will come into force on 1st September, 2013:

- (2) The description of the subject modules apply to all students who are admitted to a Bachelor Programme as per 1st September 2012 or later.

Adopted by the Board of Studies for *Mathematics* after written hearing on the 12th October 2012.

Approved by the Board of Studies for the Bachelor Study Programme in Natural Sciences on the 21st November, 2012.

Approved by the Vice-rector Hanne Leth Andersen on the 6th February, 2013.