Linnæus University

Jnr: 2018/1264-3.1.2.2

Course syllabus

Faculty of Technology
Department of Mathematics

4MAÄ02 Matematik V - inriktning mot arbete i gymnasieskolan, 15 högskolepoäng

Mathematics V - for upper secondary school teachers, 15 credits

Main field of study
Mathematics

Subject Group
Mathematics

Level of classification
Second Level

Progression
A1N

Date of Ratification
Approved 2014-12-18
Revised 2018-04-23 by Faculty of Technology. Removal of ECTS-grading scale and course evaluation is changed.
The course syllabus is valid from autumn semester 2018

Prerequisites
NO VALUE DEFINED

Objectives

Common expected learning outcomes

Otherwise, the objectives for each module are listed below.
Module 1 Mathematics, science and society, 7.5 credits
After the completed course the student is expected to be able to:

- explain the elements of philosophy of science
- explain the axiomatic-deductive method and its limitations
- give an account of ethical problems in mathematics and its applications
- reason in terms of concepts and theories of entrepreneurship, and have experience of entrepreneurial thinking in mathematics
- apply knowldege in innovation processes, from development of ideas to business models in mathematics and its applications
- write reports in LaTeX and possess mathematical writing skills
- write mathematical arguments in a popular scientific way
- present mathematical reasoning orally and using tools for presentation (e.g. Beamer), with adaptation to targeted audience groups
- participate actively in research seminars.

Module 2

Ordinary Differential Equations, 7,5 hp
The student should be able to:

- give an account for existence- and uniqueness theorems for systems of first order ordinary differential equations
- rewrite higher order one-dimensional differential equations into systems of first order differential equations
- solve systems of first order linear differential equations
- state qualitative properties for systems of first order non-linear autonomous differential equations and sketch their phase portraits
- determine stability by Liapunov functions
- linearize systems of first order non-linear differential equations
- determine periodicity and limit cycles
- describe difference equations and chaotic systems.

Algebraiska strukturer I
The student should be able to:

- define elementary concepts in the theory of algebraic structures
- describe and derive fundamental properties of groups, rings, fields and Boolean algebras
- use methods of abstract algebra in areas of mathematical or applied nature.

Content

Module 1 Mathematics, science and society, 7.5 credits

- Survey of general philosophy of science and specialization to mathematics
- Ethics: In this moment ethical aspects relevant to mathematical research and its applications in society are studied
- Entrepreneurship for mathematicians: Introduction to entrepreneurship, conditions for entrepreneurship in mathematics. From case studies we study innovation, development of ideas and commercialization. In this part of the course basic concepts of business and marketing are introduced. This moment aims at promoting a discussion about future career paths.
- Scientific and popular scientific writing --Typesetting with LaTeX, -- Mathematical writing: How to include mathematical symbols and formulas in text and how to compose a text. --Report writing: essential parts of a report, management of references.
- Contacts with contemporary research in the form of participation in adapted research seminars at the department.
- Contacts with the labor market: visits or invited lecturers from industry or public administration.

Module 2

ODE, 7,5 hp
Theorems about existence and uniqeness. Systems of first order linear differentail equations, homogeneous and non-homogeneous. Fundamental matrices. Stability and classification of critical points for autonomous systems. Liapunov functions. Periodicity and limit cycles. Something about difference equations and chaotic systems.

Algebraiska strukturer I, 7,5 hp
Group Theory: Groups and Subgroups. Cyclic Groups. Permutation Groups. Lagrange's Theorem. Fermat's and Euler's Theorems. Homomorphisms and Isomorphisms between Groups. Cayley's Theorem. Normal Subgroups and Factor Groups. Burnside's Lemma.
Ring Theory: Rings, Fields and Integral Domains. Homomorphisms and Isomorphisms between Rings. Ideals and Factor Rings. Polynomial Rings.
Boolean Algebras: Partially Ordered Sets. Bounded, Distributive, and Complemented Lattices. Boolean Algebras.

Type of Instruction

NO VALUE DEFINED

Examination

The course is assessed with the grades Fail (U), Pass (G) or Pass with Distinction (VG).
The course is examined partial through active participation in seminars, method meeting and presentations, partial through written and oral presentations of individual and group assignments, and partial through written examination/home exam.

Course Evaluation

During the course or in close connection to the course, a course evaluation is to be carried out. The result and analysis of the course evaluation are to be communicated to the students who have taken the course and to the students who are to participate in the course the next time it is offered. The course evaluation is carried out anonymously. The compiled report will be filed.

Required Reading and Additional Study Material

Module 1
Philosophy of Science - A contemporary introduction, Alex Rosenberg, Routledge, third edition or later, 2011 Suna Lowe Nielsen, Kim Klyver, Maibritt Rostgaard Evald and

Torben Bager (2012) Entrepreneurship in Theory and Practice : Paradoxes in Play Edward Elgar Publishing Ltd (236 s) Handbook of writing for the mathematical sciences, N. J. Hogham. SIAM latest edition 300(120). The not so short introduction to LaTeX, T. Oetiker et al.(http://tobi.oetiker.ch/lshort/lshort.pdf) Ethical guidelines, American Mathematical Society, (http://www.ams.org/about-us/governance/policy-statements/sec-ethics)

Module 2

Ordinary Differential Equations
Hirsch MW, Smale S, Devaney R. *Differential Equations, Dynamical Systems, and an Introduction to Chaos,* 3rd Edition, 2013, ISBN 978-0-12-382010-5, 418 pages.

Algebraic structures I
Svensson, P.-A. *Abstrakt algebra*, Studentlitteratur, 2001 or later. 229 (586) pages.