Blekinge Institute of Technology
Department of Mathematics and Natural Science

COURSE SYLLABUS

Differentialekvationer med Liegruppanalys

Differential Equations with Lie Group Analysis

7,5 ECTS credit points (7,5 högskolepoäng)

Course code: MA1437
Educational level: Basic level
Course level: G1F
Field of education: Natural sciences
Subject group: Mathematics

Subject area: Mathematics
Version: 8
Applies from: 2016-08-29
Approved: 2016-06-22
Replaces course syllabus approved: 2013-05-29

1 Course title and credit points
The course is titled Differential Equations with Lie Group Analysis/Differentialekvationer med Liegruppanalys and awards 7,5 ECTS credits. One credit point (högskolepoäng) corresponds to one credit point in the European Credit Transfer System (ECTS).

2 Decision and approval
This course is established by Department of Mathematics and Science 2013-05-29. The course syllabus was revised by Head of Department of Mathematics and Natural Science and applies from 2016-08-29.
Reg.no: BTH 4.1.1–0228-2016.
Replaces MA1417.

3 Objectives
During this course students will obtain knowledge of approaches to modelling by differential equations, basic theorems on existence of solutions and methods for analytical solving linear and non-linear ordinary and partial differential equations. Futhermore, students will develop skills in using Lie group analysis for solving nonlinear ordinary and partial differential equations.

4 Content
Part I: General discussion of differential equations:
• Selected topics from Analysis.
• Principles of mathematical modelling by differential equations, Euler-Lagrange equations.
• Mathematical modelling of wave and diffusion phenomena. The classical wave, heat and Laplace equations.
• Various types of differential equations: ordinary and partial, first and higher order, linear and nonlinear.
• Traditional methods for integration of ordinary differential equations.
• Partial differential equations of the first order. Homogeneous and nonhomogeneous linear equations, their characteristics and general solution.
Part II: Linear second-order partial differential equations:
• Characteristics and their significance. Elliptic, parabolic and hyperbolic equations.
• D'Alembert's formula for the general solution of the wave equation.
• Method of Laplace's invariants for hyperbolic equations.
• Solution of the Cauchy problem by using d'Alembert's formula.
• Solution of heat diffusion problems. Boundary and initial conditions, method of separation of variables.
Part III: Nonlinear equations. Introduction to Lie group analysis:
• Transformation groups and symmetries of differential equations.
• Integration of nonlinear ordinary differential equations using symmetries.
• Symmetry and group invariant solutions of partial differential equations.

5 Aims and learning outcomes
On completion of the course the student will be able to:
•show competence in the field of ordinary and partial differential equations.
•show analytic skills and working knowledge in Lie's integration methods.
•solve linear and non-linear differential equations.
•reduce a wast amount of nonlinear second-order ordinary equations used in applications to four canonical forms and integrate them
•know the terminology in group analysis of differential equations.

6 Learning and teaching
Teaching is conducted through lectures and

problem solving. During the course students solve recommended exercises on their own and then discuss together in the class. The final assignments, however, are solved and written by each student individually.
The teaching language is English.

7 Assessment and grading
Examination of the course

Code	Module	Credit	Grade
1310	Project 1	1 ECTS	G-U
1320	Project 2	1.5 ECTS	G-U
1330	Written examination	5 ECTS	A-F

The course will be graded A Excellent, B Very good, C Good, D Satisfactory, E Sufficient, FX Insufficient, supplementation required, F Fail.If grade FX are given, the student may after consultation with the course coordinator / examiner get an opportunity to within 6 weeks complement to grade E for the specific course element.

8 Course evaluation
The course coordinator is responsible for systematically gathering feedback from the students in course evaluations and making sure that the results of these feed back into the development of the course.

9 Prerequisites
The following courses must have been completed; MA1106 Linear Algebra, 7,5 credit points, MA1102 Calculus, 15 credit points and MA1109 Mathematics second course, 7,5 credit points or the equivalent.

10 Field of education and subject area
The course is part of the field of education and is included in the subject area Mathematics.

11 Restrictions regarding degree
The course cannot form part of a degree with another course, the content of which completely or partly corresponds with the contents of this course.

12 Course literature and other teaching material
Nail H. Ibragimov. A practical course in Differential Equations and Mathematical Modelling. Higher Education Press (China)/World Scientific. ISBN 9789814291941.
Supplementary material from the Department of Mathematics and Science can be provided.
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