Partial Differential Equations

Programme course

6 credits

Partiella differentialekvationer

TATA27

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical
Engineering, Physics and Mathematics

Date determined
2017-01-25

Main field of study
Mathematics, Applied Mathematics

Course level
Second cycle

Advancement level
A1N

Course offered for
- Mathematics, Master's programme
- Mathematics
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Linear algebra, single and multi-variable calculus, vector analysis, Fourier analysis

Intended learning outcomes

The course deals mainly with second order linear partial differential equations. It will provide some familiarity with different types of equations occurring in physics, particularly in mechanics involving heat conduction. The course also discusses questions of existence and uniqueness of solutions to these equations. Students will gain an understanding of the properties of different solutions in general, as well as some knowledge of the practical dealing with different types of boundary-value problems and initial-value problems. The course will cover numerical methods for partial differential equations, eigenvalues problems, calculus of variations and distributions. During this course students will gain knowledge of modelling of diffusion and wave phenomenon and analysis of stability, existence and uniqueness properties of solutions. After the course students should:

- be able to solve heat and wave equations, elliptic equations and eigenvalue-problems associated with them, using transformations and separation variables.
- have knowledge about existence and uniqueness results and numerical methods for PDE.
- be able to use calculus of variations and distributions.

Course content

Origin of PDEs. Derivation of the heat equation, Laplace's equation and the wave equation, starting from physical balance laws. Classification of equations. Properties of harmonic functions. Connections with complex analysis. General properties of elliptic equations. Properties of solutions of time-dependent problems. Wave propagation. Integral transforms. Green's function. Distributions. The fundamental solution. Maximum principles. Weak solutions, weak formulation. Existence and uniqueness results. Numerical methods for PDE. Simple error analysis. Eigenvalue problems. Calculus of variations.

Teaching and working methods

Teaching is done with combined lectures/exercises.
The course runs over the entire spring semester.

Examination

TEN1	Written examination	6 credits	U, 3, 4, 5

Grades

Four-grade scale, LiU, U, 3, 4, 5

Department
Matematiska institutionen

Director of Studies or equivalent
Jesper Thorén

Examiner
David Rule

Course website and other links

Education components
Preliminary scheduled hours: 48 h
Recommended self-study hours: 112 h

Course literature
Strauss, W.A: Partial Differential Equations. An introduction. John Wiley & Sons 2008. Evans, L.W: Partial Differential Equations. American Mathematical Society, 1998. Folland, G.B: Introduction to Partial Differential Equations, Princeton University Press 1995.

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.