

WINTER SEMESTER 2015/16 - NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS

Lecture. Tuesday and Friday 11 am - 1 pm, RUD 25, room 1.115

Recitation. Friday 1 - 3 pm, RUD 25, room 3.008

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Office hours. Tuesday 2 - 3 pm

Contents. This course is a continuation of Higher Analysis I (Linear Partial Differential Equations) and is dedicated to systems of partial differential equations as well as nonlinear partial differential equations. Topics include boundary value problems for elliptic and hyperbolic systems, non-linear elliptic equations and hyperbolic conservation laws.

This course will start with examples of linear and nonlinear partial differential equations, in particular the elastic wave equations and the Maxwell equations. A number of problems will be discussed which will motivate and guide us throughout this course. We will prove statements concerning the existence, uniqueness and stability of solutions to various problems concerning systems of linear and nonlinear partial differential equations.

A few more words about the techniques to be studied in this course. In a functional analytic setting a differential operator is a mapping between suitably chosen function spaces. Our preferred choice will be the scale of Sobolev spaces encountered in a course on linear partial differential equations. To solve a problem uniquely means to prove continuous invertibility of this mapping. If the operator is not surjective or not injective we will aim for a description of its range and its kernel, respectively. In the theory of partial differential equations it is common to summarize these kind of considerations with estimates which bound the norm of the solution in some function space in terms of some norms of the data (right-hand side function and/or boundary data).

Prerequisites. Higher Analysis I (Functional analysis), Higher Analysis II (Linear Partial Differential Equations).

Homework. Homework problems will be published with a due date on my web page which can be found via the departmental homepage <https://www.mathematik.hu-berlin.de/de/> You have the possibility to work on some of these problem during the recitation section. You are encouraged to turn in at least 50% of the homework problems for me to correct.

Final Exam. The final exam is a written exam. The first available date is on the last day of classes, February 12, 2016. The alternative date will be published at a later time.

Books. A course dedicated to this vast area of mathematics can only cover a small selection of topics. For your studies I recommend the following books which I have relied on when preparing my lectures.

- M. Renardy and R. Rogers: An Introduction to Partial Differential Equations, Springer-Verlag 1993, 2nd edition 2004
- D. Serre: Systems of conservation laws 1, Cambridge 1999
- D. Serre: Systems of conservation laws 2, Cambridge 2000
- J. Wloka: Partielle Differentialgleichungen, Teubner 1980
- M. Taylor: Partial Differential Equations I, Springer 1996