UPPSALA UNIVERSITY
DEPARTMENT OF MATHEMATICS
Jörgen Östensson

Introduction to PDE, 5 hp
Spring 2011

Introduction to Partial Differential Equations

Course literature

Yehuda Pinchover and Jacob Rubinstein, *An Introduction to Partial Differential Equations*, Cambridge University Press.

Course web page

My web page can be reached from the staff page of the mathematics department:

http://www.math.uu.se/Employees/

Here you can find information about the course, e.g. materials handed out in class.

Teaching

Teaching consists of 15 lectures. These lectures will mainly be devoted to the basic theory. You are strongly advised to solve additional problems on your own.

The course material is shown under the heading "Sections in book" in the lecture plan below. I will certainly not have time to cover everything in class, during which I can only hope to explain basic ideas and the most fundamental results. You are expected to study the rest on your own.

Examination

The course finishes on the 4th of March with a written exam. Maximum score: 40 points. A total score of 18 is needed for the grade 3, 25 for the grade 4, and 32 for the grade 5.

Preliminary lecture plan

Lecture	Contents	Sections in book
1	Introduction.	1.1–1.6
2–3	Quasilinear first order equations. The method of characteristics.	2.1–2.6
4	Second order equations.	3.1–3.5
5	The one-dimensional wave equation.	4.1–4.5
6–7	The method of separation of variables.	5.1–5.6
8-9	Sturm-Liouville problems.	6.1–6.6
10–11	Elliptic equations. Maximum principles.	7.1–7.8
12-13	Green's functions and integral representations.	8.1–8.4, 9.11–9.12
14	Eigenvalues of the Laplace operator.	9.5–9.10
15	Reserve. Problem solving.	

Learning outcomes

In order to pass the course (grade 3) the student should

- know the most common partial differential equations that appear in problems concerning e.g. heat conduction, flow, elasticity and wave propagation;
- understand basic questions concerning the existence and uniqueness of solutions, and continous dependence of initial and boundary data;
- be able to solve simple first order equations using the method of characteristics;
- know the classification of second order equations;
- be able to solve simple initial and boundary value problems using e.g. d'Alembert's solution formula, separation of variables, Fourier series expansion or expansion in other orthogonal systems;
- be able to compute and analyze wave propagation and heat conduction and describe in mathematical terms;
- be able to formulate maximum principles for various equations and derive consequences.

Contents

First order equations. Classification of second order equations: elliptic, parabolic and hyperbolic. Physical models. Various solution techniques. Green functions. Maximum principles.

Uppsala, 11th of January 2011.

Jörgen Östensson