Johannes Zimmer Second Semester 2009–2010

MA30170/MA50170 Numerical Solution of PDEs I

Information Sheet

Schedule of class. There will be three classes per week.

Lecture 1:	Monday	12.15pm	in 3E 3.8
Lecture 2:	Thursday	11.15am	in 8W 2.1
Problem Class:	Thursday	12.15am	in 8W 2.1

Note that occasionally, for example in the first week, the problem class will be used for a lecture as well.

Content of lectures. The course will teach you how to derive and implement the finite element method for a range of standard elliptic (and parabolic) partial differential equations in one and several space dimensions. In particular a large part of the course will be devoted to deriving and using elementary error estimates for these methods.
This course is on Numerical Analysis. This is a part of applied mathematics and is concerned with the analysis of numerical computer methods for solving various applied problems. Also students should be aware that the whole of the very active subject of numerical analysis has grown out of the fact that computers exist and are widely used. Thus the problem sheets will contain some exercises which require the writing of simple `MATLAB` programs and others which involve running and modifying previously written programs. These are preparation for the coursework which will involve calculations as well as mathematical analysis. The level of programming expertise required is the level which was taught in **MA10126** and **MA20014**. If you want to brush up on your `MATLAB` you are encouraged to refer to the manual at `http://www.maths.bath.ac.uk/~zimmer/teaching/classes/9-0/30170/literature/short_manual_windows.pdf`. I will be happy to answer `MATLAB` questions in class. This is not a course on programming, but you are expected to have basic programming skills. Questions on programming will not be asked in the written final examination. However, some `MATLAB` computing will be required in the assignment.
Note. Students taking the Level 5 version **MA50170** of the course will also have to study some extra material on the application of FEM to parabolic problems. This will be done through guided independent reading of the relevant sections in [4] (see below).

Weekly Problem Sheets. Each week some problem sheet questions will be set. Doing the problem sheet questions is an *essential* part of the course. Even though these problem sheets are not part of the assessed coursework, in later assessed coursework and in the exam it will be *assumed* that you have done these questions. Moreover the content of the classes in subsequent weeks will be designed on the assumption that you have done the problem sheets.

The homework will normally be handed out on Mondays and is due on the following Tuesday at 10:15 (there is a folder marked MA30170/MA50170 outside 1W3.9b for you to hand in your solutions).

Assessment scheme MA30170 (BSc version). Exam 75%, Assignment 25%. The Assignment will be set in Week 5 and is due on Friday 26th March (Week 7) at 12.30 in the Departmental Office.

Assessment scheme MA50170 (MSc version). Exam 60%, Assignment 15%, Class Test 25%. The Assignment will be set in Week 5 and is due on Friday 26th March (Week 7) at 12.30 in the Departmental Office. The Class Test will be on FEM for parabolic PDEs (Sections 8.1–8.4.2 in [4]), *date to be fixed*.

Resources. The web page for the course is `http://www.maths.bath.ac.uk/~zimmer/teaching/classes/9-0/30170/ma30170.html`.
This is referred to throughout the course as the *homepage*, and you will find on it lecture notes, handouts, pages with useful links etc.
Computing for this course will be done using the `MATLAB` system running on BUCS, available on `bucs` (Unix), `lcpu` (Linux) and Gigaterms (Windows). These machines can be accessed from any campus PC, and via Remote Desktop and VPN from off campus. See `http://www.bath.ac.uk/bucs` for more information. Any programs for the examples/exercises will be available on the course web-site.

Main References. There is no set text for this course, and the lectures will be self-contained. However the following books are useful background for some parts of the course.

[1] Dietrich Braess. *Finite elements*. Cambridge University Press, Cambridge, third edition, 2007. Theory, fast solvers, and applications in elasticity theory, Translated from the German by Larry L. Schumaker.

[2] Susanne C. Brenner and L. Ridgway Scott. *The mathematical theory of finite element methods*, volume 15 of *Texts in Applied Mathematics*. Springer, New York, third edition, 2008.

[3] Arieh Iserles. *A first course in the numerical analysis of differential equations*. Cambridge Texts in Applied Mathematics. Cambridge University Press, Cambridge, second edition, 2009.

[4] Claes Johnson. *Numerical solution of partial differential equations by the finite element method*. Cambridge University Press, Cambridge, 1987.

There are some copies of all these books in the library, possibly of older editions.

General. I hope you will enjoy the course. Please do not hesitate to contact me if you have any problems. My email is `zimmer@maths.bath.ac.uk`, my phone number is (012 225) 38 60 97.
I want you to understand everything we discuss in class. Please identify the topics you find difficult to understand, and discuss them with your colleagues. Please come and see me if the problem persists.