School of Mathematics

Course 461 — Numerical Solution of Differential Equations I 1998-99
(Optional JS & SS Mathematics)

Lecturer: Dr J Sexton

Requirements/prerequisites: 261

Duration: 24 weeks

Number of lectures per week: 3 (including tutorials)

Assessment: Examination and Project (some years)

End-of-year Examination: One 3-hour examination

Description:

1. Elliptic Boundary Value Problems

   1.1 Abstract Problems
   The symmetric case. Variational inequalities
   The nonsymmetric case. The Lax-Milgram lemma

   1.2 Examples of elliptic boundary value problems
   The Sobolev spaces $H^m(\Omega)$. Green's formulas
   First examples of second-order boundary value problems
   The elasticity problem
   Examples of fourth-order problems: The biharmonic problem, the plate problem.

2. Introduction to the Finite Element Method

   2.1 Basic aspects of the finite element method
   The Galerkin and Ritz methods
   The three basic aspects of the finite element method. Conforming finite element methods

   2.2 Examples of finite elements and finite element spaces
   Requirements for finite element spaces
   First examples of finite elements for second order problems : n- Simplicies of type $(k), (3')$
   Assembly in triangulations. The associated finite element spaces n-Rectangles of type (k). Rectangles of type (2'), (3'). Assembly in triangulations
   First examples of finite elements with derivatives as degrees for freedom: Hermite $n-$ simplicies of type (3), (3'). Assembly in triangulations
   First examples of finite elements for fourth-order problems: the Argyris and Bell triangles, the Bogner-Fox-Schmit rectangle. Assembly in triangulations

   2.3 General properties of finite elements and finite element spaces
   Finite elements as triples (K, P, Σ). Basic definitions. The P-interpolation operator
   Affine families of finite elements

June 10, 1998