MA949-15 Applied and Numerical Analysis for Linear PDEs

21/22

Department
Warwick Mathematics Institute
Level
Research Postgraduate Level
Module leader
Jose Rodrigo
Credit value
15
Module duration
10 weeks
Assessment
50% coursework, 50% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

The module will introduce students to the analysis and numerical approximation of variational solutions of linear PDEs

Module aims

Students will learn about the variational formulation of linear PDEs, how to prove existence and uniqueness of weak solutions, and how to approximate these problems using Galerkin methods.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

- Hilbert and Banach spaces
- Lebesgue integration and the spaces.
- Sobolev spaces and their relationship to spaces of continuous and integrable functions.
- The Riesz Representation Theorem and Lax-Milgram Lemma, and their application to elliptic

PDEs.
- Galerkin approximations
- Introduction to Finite element methods
- Approximation theory and a-priori error analysis

Learning outcomes

By the end of the module, students should be able to:

- After completing this module, students will be able to: Recall the definition of the Sobolev spaces and their connection to other function spaces Formulate notions of weak solutions for linear elliptic PDEs. Apply Hilbert space theory to prove existence of weak solutions to linear elliptic PDEs. Use finite element methods in order to numerically solve linear elliptic PDEs Prove a-priori error estimates for finite element approximations

Indicative reading list

Elliptic Partial Differential Equations of Second Order. (2nd edition). D Gilbarg, N S Trudinger, Springer.
Sobolev Spaces (Second Edition). Robert A Adams and John J F Fournier, Academic Press.
Dietrich Braess, Finite Elements: Theory, Fast Solvers, and Applications in Solid Mechanics (3rd edition), Cambridge University Press (2007).
S Brenner and L Ridgeway Scott, The mathematical theory of finite element methods (3rd edition), Springer Texts in Applied Mathematics Volume 15 (2008).

Subject specific skills

- Develop a deep understanding and applicability of the variational formulation of linear PDEs,
- how to prove existence and uniqueness of weak solutions, and
- how to approximate these problems using Galerkin methods

Transferable skills

- sourcing research material
- prioritising and summarising relevant information
- absorbing and organizing information
- presentation skills (both oral and written)

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Private study	120 hours (80%)
Total	150 hours

Private study description

Review lectured material.
Work on suplementary reading material.
Source, organise and prioritise material for additional reading.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time
Course Project	50%	
An essay (about 16 pages) on a topic discussed between the lecturer and the student.		
Oral Exam	50%	
An oral exam involving a presentation by the student, followed by questions from the panel (2 members of the department)		

Feedback on assessment

A copy of the essay with comments will be returned to the student.\r\nStudents will receive feedback from the course instructor after the oral exam, to cover also areas like presentation skills and use of technologies (or blackboard)

Past exam papers for MA949

Availability

There is currently no information about the courses for which this module is core or optional.