MA250-10 Partial Differential Equations

24/25

Department
Warwick Mathematics Institute
Level
Undergraduate Level 2
Module leader
Marie-Therese Wolfram
Credit value
10
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

The theory of partial differential equations (PDE) is important both in pure and applied mathematics. On the one hand they are used to mathematically formulate many phenomena from the natural sciences (electromagnetism, Maxwell's equations) or social sciences (financial markets, Black-Scholes model). On the other hand since the pioneering work on surfaces and manifolds by Gauss and Riemann partial differential equations have been at the centre of many important developments on other areas of mathematics (geometry, Poincare-conjecture).

Module web page

Module aims

The module aims at providing a broad perspective on the subject, and illustrate the rich variety of phenomena which can be described by PDEs. It will provide students with the most important techniques to construct so-called classic solutions to PDEs – the methods of characteristics, the method of the separation of variables as well as Fourier series. Students will learn to differentiate cetrain types of PDEs and comprehend their inherent characteristics. The modeule will also illustrate how PDEs arise naturally in the phyiscal and life sciences.

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.

The course will start with an introduction to PDES, outlining what PDEs actually are, how some of them can be classified, how do they arise in physics and the life sciences, and what the notion of well-posedness means. It will mainly focus on three classical equations – the heat equation, the wave equation and the Laplace equation – on unbounded and bounded domains.

Learning outcomes

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

- understand and apply fundamental physical principles to derive certain types of PDEs.
- the ability to differentiate between various types of PDEs and comprehend the distinctions in their inherent characteristics.
- calculate solutions to the three main types of PDEs on unbounded and bounded domains
- You will also understand that properties of solutions to PDEs sensitively depend on the type.

Indicative reading list

A script based on the lecturer's notes will be provided. For further reading you may find the following books useful (sections of relevance will be pointed out in the script or in the lectures):
S Salsa: Partial differential equations in action, from modelling to theory. Springer (2008).
A Tveito and R Winther: Introduction to partial differential equations, a computational approach. Springer TAM 29 (2005).
W Strauss: Partial differential equations, an introduction. John Wiley (1992).
JD Logan: Applied partial differential equations. 2nd edt. Springer (2004).
MP Coleman: An introduction to partial differential equations with MATLAB. Chapman and Hall (2005).
M Renardy and RC Rogers: An introduction to partial differential equations, Springer TAM 13 (2004).
LC Evans: Partial differential equations. 2nd edt. American Mathematical Society GMS 19 (2010).

Subject specific skills

At the end, students will be familiar with the notion of well-posed PDE problems and have an idea what kind of initial or boundary conditions may be imposed for this purpose. Students will have studied some techniques which enable you to solve some simple PDE problems. They will also understand that properties of solutions to PDEs sensitively depend on the type.

Transferable skills

The module provides technical competence in solving basic partial differential equations that feature at least as building blocks in applications. There are aspects of critical thinking and creativity related to analysing and solving PDE problems.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (30%)
Seminars	9 sessions of 1 hour (9%)
Private study	61 hours (61%)
Total	100 hours

Private study description

Review lectured material and work on set exercises.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group B1

	Weighting	Study time
Examination	100%	

- Answerbook Pink (12 page)

Assessment group R1

	Weighting	Study time
In-person Examination - Resit	100%	

- Answerbook Pink (12 page)

Feedback on assessment

Exam feedback.

Past exam papers for MA250

Availability

Courses

This module is Core for:

- UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
  - Year 2 of GF13 Mathematics and Physics
  - Year 2 of GF13 Mathematics and Physics
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
  - Year 2 of FG31 Mathematics and Physics (MMathPhys)
  - Year 2 of FG31 Mathematics and Physics (MMathPhys)

This module is Core option list A for:

- UMAA-GV17 Undergraduate Mathematics and Philosophy
  - Year 2 of GV17 Mathematics and Philosophy
  - Year 2 of GV17 Mathematics and Philosophy
  - Year 2 of GV17 Mathematics and Philosophy
- Year 2 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list B for:

- Year 3 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list D for:

- Year 4 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Option list A for:

- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
  - Year 2 of G105 Mathematics (MMath) with Intercalated Year
  - Year 4 of G105 Mathematics (MMath) with Intercalated Year
- UMAA-G100 Undergraduate Mathematics (BSc)
  - Year 2 of G100 Mathematics
  - Year 2 of G100 Mathematics
  - Year 2 of G100 Mathematics
  - Year 3 of G100 Mathematics
  - Year 3 of G100 Mathematics
  - Year 3 of G100 Mathematics
- UMAA-G103 Undergraduate Mathematics (MMath)
  - Year 2 of G100 Mathematics

    - Year 2 of G103 Mathematics (MMath)
    - Year 2 of G103 Mathematics (MMath)
    - Year 3 of G100 Mathematics
    - Year 3 of G103 Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
- Year 2 of UMAA-G1NC Undergraduate Mathematics and Business Studies
- Year 2 of UMAA-G1N2 Undergraduate Mathematics and Business Studies (with Intercalated Year)
- Year 2 of UMAA-GL11 Undergraduate Mathematics and Economics
- Year 2 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercalated Year)
- USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
    - Year 2 of GG14 Mathematics and Statistics
    - Year 2 of GG14 Mathematics and Statistics
- UMAA-G101 Undergraduate Mathematics with Intercalated Year
    - Year 2 of G101 Mathematics with Intercalated Year
    - Year 4 of G101 Mathematics with Intercalated Year

This module is Option list B for:

- UCSA-G4G1 Undergraduate Discrete Mathematics
    - Year 2 of G4G1 Discrete Mathematics
    - Year 2 of G4G1 Discrete Mathematics
- Year 2 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 3 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and Economics
    - Year 2 of Y602 Mathematics,Operational Research,Stats,Economics
    - Year 2 of Y602 Mathematics,Operational Research,Stats,Economics