MA250-12 Partial Differential Equations

23/24

Department
Warwick Mathematics Institute
Level
Undergraduate Level 2
Module leader
Bjorn Stinner
Credit value
12
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

To introduce the basic phenomenology of partial differential equations and their solutions. To construct solutions using classical 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.

Subject of the module are four significant partial differential equations (PDEs) which feature as basic components in many applications:
The transport equation, the wave equation, the heat equation, and the Laplace equation. We will

discuss the qualitative behaviour of solutions and, thus, be able to classify the most important partial differential equations into elliptic, parabolic, and hyperbolic type. Possible initial and boundary conditions and their impact on the solutions will be investigated. Solution techniques comprise the method of characteristics, Green's functions, and Fourier series.

Learning outcomes

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

- At the end, you 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.
- You will have studied some techniques which enable you to solve some simple PDE problems.
- 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 (77%)
Tutorials	9 sessions of 1 hour (23%)
Total	39 hours

Private study description

Review lectured material and work on set exercises.

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group B1

	Weighting	Study time
In-person Examination	100%	

- Answerbook Pink (12 page)

Assessment group R1

	Weighting	Study time
In-person Examination - Resit	100%	

- Answerbook Pink (12 page)

Assessment group S

	Weighting	Study time
In-person Examination	100%	

- Answerbook Pink (12 page)

Feedback on assessment

Exam feedback.

Past exam papers for MA250

Availability

Courses

This module is Core for:

- Year 2 of UPXA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)

This module is Core optional for:

- Year 2 of UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 2 of G103 Mathematics (MMath)
    - Year 2 of G103 Mathematics (MMath)
- Year 2 of UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe

This module is Optional for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
- Year 3 of UMAA-GL11 Undergraduate Mathematics and Economics

This module is Core option list B for:

- UMAA-GV17 Undergraduate Mathematics and Philosophy
    - Year 3 of GV17 Mathematics and Philosophy
    - Year 3 of GV17 Mathematics and Philosophy
    - Year 3 of GV17 Mathematics and Philosophy

This module is Core option list C for:

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

This module is Core option list D for:

- UMAA-GV18 Undergraduate Mathematics and Philosophy with Intercalated Year
    - Year 4 of GV18 Mathematics and Philosophy with Intercalated Year
    - Year 4 of GV18 Mathematics and Philosophy with Intercalated Year

This module is Option list A for:

- Year 3 of UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
- Year 2 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
- UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
    - Year 2 of G106 Mathematics (MMath) with Study in Europe
    - Year 3 of G106 Mathematics (MMath) with Study in Europe

This module is Option list B for:

- Year 4 of USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
- USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
    - Year 3 of GG14 Mathematics and Statistics
    - Year 3 of GG14 Mathematics and Statistics
- Year 4 of USTA-GG17 Undergraduate Mathematics and Statistics (with Intercalated Year)
- USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and Economics
    - Year 3 of Y602 Mathematics,Operational Research,Stats,Economics
    - Year 3 of Y602 Mathematics,Operational Research,Stats,Economics
- Year 4 of USTA-Y603 Undergraduate Mathematics,Operational Research,Statistics,Economics (with Intercalated Year)

This module is Option list E for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
- USTA-G301 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics (with Intercalated
    - Year 3 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
    - Year 4 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)