# MA350-10 Partial Differential Equations

## 24/25

**Department**
: Warwick Mathematics Institute

**Level**
: Undergraduate Level 3

**Module leader**
: Marie-Therese Wolfram

**Credit value**
: 10

**Module duration**
: 10 weeks

**Assessment**
: Multiple

**Study location**
: University of Warwick main campus, Coventry

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## 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 discriminate between various types of PDEs and comprehend the distinctions in their inherent characteristics.
- study solutions to the three key types of PDEs on unbounded and bounded domains
- deep understanding on how the 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.

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## Assessment

You must pass all assessment components to pass the module.

### Assessment group B

| | Weighting | Study time |
|---|---|---|
| Examination | 100% | |

- Answerbook Pink (12 page)

### Assessment group R

| | Weighting | Study time |
|---|---|---|
| In-person Examination - Resit | 100% | |

- Answerbook Pink (12 page)

### Feedback on assessment

Exam feedback.

Past exam papers for MA350

## Availability

### Anti-requisite modules

If you take this module, you cannot also take:

- MA250-10 Partial Differential Equations

## Courses

This module is Core option list A 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 Core option list C 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
- Year 3 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list F for:

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

This module is Option list A for:

- Year 4 of UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
- UMAA-G100 Undergraduate Mathematics (BSc)
    - Year 3 of G100 Mathematics
    - Year 3 of G100 Mathematics
    - Year 3 of G100 Mathematics
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 3 of G100 Mathematics
    - Year 3 of G103 Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
- Year 4 of UMAA-G101 Undergraduate Mathematics with Intercalated Year