# ACE Network Subject Information Guide

## Partial Differential Equations

## Semester 2, 2023

## Administration and contact details

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|---|---|
| **Host department** | School of Mathematics |
| **Host institution** | Monash University |
| | |
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| | |
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| **Name of masters coordinator** | Jerome Droniou |
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## Subject details

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|---|---|
| **Handbook entry URL** | https://handbook.monash.edu/2020/units/MTH5123 |
| **Subject homepage URL** | Click here to enter text. |
| **Honours student hand-out URL** | Click here to enter text. |
| | |
| **Start date:** | Click here to enter a date. |
| **End date:** | Click here to enter a date. |
| **Contact hours per week:** | Click here to enter text. |
| **Census date:** | Click here to enter a date. |
| **Lecture day(s) and time(s):** | Click here to enter text. |
| | |
| **Description of electronic access arrangements for students (for example, WebCT)** | Click here to enter text. |

## Subject content

### 1. Subject content description

Partial Differential Equations are ubiquitous in the modelling of physical phenomena. This topic will introduce the modern tools for a class of dispersive partial differential equations, in particular the nonlinear Schrodinger equation. Fourier analysis, one of the most powerful tools of modern analysis, will also be covered. The following topics are covered in the unit: Fourier transform, distribution theory, Sobolev spaces theory, Littlewood-Paley dyadic decomposition, Bony's paraproduct decomposition, Strichartz estimates, well-posedness for nonlinear Schr\"odinger equations

## 2. Week-by-week topic overview

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|---|
| 1 Lebesgue space and linear operators |
| 2 Fourier transform: L1 theory |
| 3 Fourier transform: L2 theory |
| 4 Distribution theory |
| 5 Fourier transform on Schwartz distribution |
| 5 Application I: linear equations |
| 6 Application II: nonlinear equations |
| 7 Fourier multiplier and Littlewood-Paley dyadic decomposition |
| 8 Sobolev space, Bony's paraproduct decomposition |
| 9 Nonlinear Schrodinger equation: local well-posedness |
| 10 Strichartz estimates for Schrodinger equation |
| 11 Nonlinear Schrodinger equation: global well-posedness |
| 12 Elliptic equation and nonlinear Schrodinger equation |

## 3. Assumed prerequisite knowledge and capabilities

Real analysis
Functional analysis (Banach space, Hilbert space, linear operator),
Measure theory (Lebesgue integration)

## 4. Learning outcomes and objectives

- Synthetise advanced mathematical knowledge in the basic theory of fundamental PDEs.
- Interpret the construction of `generalised functions' (distribution) and how it relates to modern notions of derivative and function spaces.
- Synthetise techniques and properties of Fourier Analysis.
- Apply sophisticated Fourier analysis methods to problems in PDEs and related fields.
- Apply recent developments in research on PDEs

**AQF specific Program Learning Outcomes and Learning Outcome Descriptors (if available):**

| AQF Program Learning Outcomes addressed in this subject | Associated AQF Learning Outcome Descriptors for this subject |
|---|---|
| Insert Program Learning Outcome here | Choose from list below |
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**Learning Outcome Descriptors at AQF Level 8**
**Knowledge**
K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines
K2: knowledge of research principles and methods
**Skills**
S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence
S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas
S3: cognitive skills to exercise critical thinking and judgement in developing new understanding
S4: technical skills to design and use in a research project
S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences
**Application of Knowledge and Skills**
A1: with initiative and judgement in professional practice and/or scholarship
A2: to adapt knowledge and skills in diverse contexts
A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters
A4: to plan and execute project work and/or a piece of research and scholarship with some independence

## 5. Learning resources

Lecture notes for printout.

## 6. Assessment

| **Exam/assignment/classwork breakdown** | | | | | |
|---|---|---|---|---|---|
| **Exam** | 60% | **Assignment** | 40% | **Class work** | |
| | | | | | |
| **Assignment due dates** | | Click here to enter a date. | Click here to enter a date. | Click here to enter a date. | Click here to enter a date. |
| | | | | | |
| **Approximate exam date** | | | | Click here to enter a date. | |

## Institution honours program details

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|---|---|
| **Weight of subject in total honours assessment at host department** | 1/16 |
| **Thesis/subject split at host department** | thesis is worth 1/4 of the whole Master |
| **Honours grade ranges at host department** | |
| **H1** | HD: 80% and above |
| **H2a** | D: 70-79% |
| **H2b** | C: 60-69% |
| **H3** | P: 50-59% |

## Institution masters program details

| | |
|---|---|
| **Weight of subject in total masters assessment at host department** | 1/16 |
| **Thesis/subject split at host department** | thesis is worth 1/4 of the whole Master |
| **Masters grade ranges at host department** | |
| **H1** | HD: 80% and above |
| **H2a** | D: 70-79% |
| **H2b** | C: 60-69% |
| **H3** | P: 50-59% |