MATH3906
Partial Differential Equations
Session 2, In person-scheduled-weekday, North Ryde 2023

School of Mathematical and Physical Sciences

Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Information</td>
<td>2</td>
</tr>
<tr>
<td>Learning Outcomes</td>
<td>2</td>
</tr>
<tr>
<td>General Assessment Information</td>
<td>3</td>
</tr>
<tr>
<td>Assessment Tasks</td>
<td>4</td>
</tr>
<tr>
<td>Delivery and Resources</td>
<td>7</td>
</tr>
<tr>
<td>Unit Schedule</td>
<td>7</td>
</tr>
<tr>
<td>Policies and Procedures</td>
<td>8</td>
</tr>
<tr>
<td>Changes from Previous Offering</td>
<td>10</td>
</tr>
</tbody>
</table>

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General Information

Unit convenor and teaching staff
Justin Tzou
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Lecturer
Stuart Hawkins
stuart.hawkins@mq.edu.au

Credit points
10

Prerequisites
(MATH2010 or MATH235) and (MATH2020 or MATH2110 or MATH232 or MATH236)

Corequisites
MATH3901 or MATH3902 or MATH3905 or MATH3909 or MATH331 or MATH332 or MATH335 or MATH339

Co-badged status

Unit description
Partial differential equations form one of the most fundamental links between pure and applied mathematics. Many problems that arise naturally from physics and other sciences can be described by partial differential equations. Their study gives rise to the development of many mathematical techniques, and their solutions enrich both mathematics and their areas of origin. This unit explores how partial differential equations arise as models of real physical phenomena, and develops various techniques for solving them and characterising their solutions. Special attention is paid to three partial differential equations that have been central in the development of mathematics and the sciences - Laplace's equation, the wave equation and the diffusion equation.

Important Academic Dates
Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes
On successful completion of this unit, you will be able to:

ULO2: Use the ideas and techniques of the theory of partial differential equations to model a broad range of phenomena in science and engineering (in particular using the
heat and wave equations).

**ULO1:** Have knowledge of the principles and concepts of a basic theory of partial differential equations.

**ULO3:** Understand the breadth of the theory of partial differential equations and its role in other fields.

**ULO5:** Demonstrate efficient use of Fourier analysis techniques in the theory of partial differential equations.

**ULO4:** Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning especially in the context of the theory of partial differential equations.

**ULO6:** Further studies in the areas of partial differential equations and advanced analysis.

**General Assessment Information**

To pass this unit, you must:

- achieve a total mark equal to or greater than 50%.

**Late Assessment Submission Penalty**

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark of the task) will be applied for each day a written report or presentation assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of ‘0’ will be awarded even if the assessment is submitted. The submission time for all uploaded assessments is 11:55 pm. A 1-hour grace period will be provided to students who experience a technical concern. For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, please apply for Special Consideration.

**Assessments where Late Submissions will be accepted:**

Assignment 1 – YES, Standard Late Penalty applies Assignment 2 – YES, Standard Late Penalty applies Mid-semester test - NO, unless Special Consideration is Granted

**Special Consideration**

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the convenor and submit a Special Consideration request through ask.mq.edu.au.
Descriptions of Assessment Activities

Both assignments and the midsemester test will be written assessments - scan your written solutions and submit on iLearn. The midsemester test will be time-limited.

Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Hurdle</th>
<th>Due</th>
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</thead>
<tbody>
<tr>
<td>Mid-semester test</td>
<td>10%</td>
<td>No</td>
<td>Week 8</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>15%</td>
<td>No</td>
<td>Friday Week 11</td>
</tr>
<tr>
<td>Final exam</td>
<td>60%</td>
<td>No</td>
<td>exam period</td>
</tr>
<tr>
<td>Assignment 1</td>
<td>15%</td>
<td>No</td>
<td>Friday Week 6</td>
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Mid-semester test

Assessment Type 1: Quiz/Test
Indicative Time on Task 2: 8 hours
Due: Week 8
Weighting: 10%

Test based on material from lectures in previous weeks.

On successful completion you will be able to:

- Use the ideas and techniques of the theory of partial differential equations to model a broad range of phenomena in science and engineering (in particular using the heat and wave equations).
- Have knowledge of the principles and concepts of a basic theory of partial differential equations.
- Understand the breadth of the theory of partial differential equations and its role in other fields.
- Demonstrate efficient use of Fourier analysis techniques in the theory of partial differential equations.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning especially in the context of the theory of partial differential equations.
Further studies in the areas of partial differential equations and advanced analysis.

Assignment 2
Assessment Type: Problem set
Indicative Time on Task: 9 hours
Due: Friday Week 11
Weighting: 15%

Assignment based on material from lectures in previous weeks.

On successful completion you will be able to:

- Use the ideas and techniques of the theory of partial differential equations to model a broad range of phenomena in science and engineering (in particular using the heat and wave equations).
- Have knowledge of the principles and concepts of a basic theory of partial differential equations.
- Understand the breadth of the theory of partial differential equations and its role in other fields.
- Demonstrate efficient use of Fourier analysis techniques in the theory of partial differential equations.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning especially in the context of the theory of partial differential equations.
- Further studies in the areas of partial differential equations and advanced analysis.

Final exam
Assessment Type: Examination
Indicative Time on Task: 20 hours
Due: exam period
Weighting: 60%

This will be held during the final exam period. It will test the ability of students to synthesise the concepts taught in the course in order to analyse and solve partial differential equations.

On successful completion you will be able to:
Use the ideas and techniques of the theory of partial differential equations to model a broad range of phenomena in science and engineering (in particular using the heat and wave equations).

Have knowledge of the principles and concepts of a basic theory of partial differential equations.

Understand the breadth of the theory of partial differential equations and its role in other fields.

Demonstrate efficient use of Fourier analysis techniques in the theory of partial differential equations.

Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning especially in the context of the theory of partial differential equations.

Further studies in the areas of partial differential equations and advanced analysis.

Assignment 1

Assessment Type: Problem set
Indicative Time on Task: 9 hours
Due: Friday Week 6
Weighting: 15%

Assignment based on material from lectures in previous weeks.

On successful completion you will be able to:

- Use the ideas and techniques of the theory of partial differential equations to model a broad range of phenomena in science and engineering (in particular using the heat and wave equations).
- Have knowledge of the principles and concepts of a basic theory of partial differential equations.
- Understand the breadth of the theory of partial differential equations and its role in other fields.
- Demonstrate efficient use of Fourier analysis techniques in the theory of partial differential equations.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning especially in the context of the theory of partial differential equations.
Further studies in the areas of partial differential equations and advanced analysis.

If you need help with your assignment, please contact:
- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation.

**Delivery and Resources**

The *required* textbook for this unit is: *Introduction to Partial Differential Equations* (Peter J. Olver)

This text is available **free and online** through the MQ library service. Please ensure that you have this text available to you. We will assign readings, and draw questions and examples from this text. Most of the lectures will be directly based on the contents of this text.

SGTAs will begin in Week 1.

We will communicate with you via your university email or through announcements on iLearn. Queries to convenors can either be placed on the iLearn discussion board or sent to the convenor via email.

For the latest information on the University’s response to COVID-19, please refer to the Coronavirus infection page on the Macquarie website: [https://www.mq.edu.au/about/coronavirus-faqs](https://www.mq.edu.au/about/coronavirus-faqs). Remember to check this page regularly in case the information and requirements change during semester. If there are any changes to this unit in relation to COVID, these will be communicated via iLearn.

**Unit Schedule**

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>OLVER READING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Introduction to PDEs</td>
</tr>
<tr>
<td></td>
<td>Chapter 1, Section 2.1</td>
</tr>
<tr>
<td>Week 2</td>
<td>Method of Characteristics</td>
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<tr>
<td></td>
<td>Section 2.2</td>
</tr>
<tr>
<td>Week 3</td>
<td>Method of Characteristics</td>
</tr>
<tr>
<td></td>
<td>Sections 2.3 - 2.4</td>
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</tbody>
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Unit guide MATH3906 Partial Differential Equations

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<thead>
<tr>
<th>TOPIC</th>
<th>OLVER READING</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Week 4</td>
<td>Linear Second-Order PDEs</td>
<td>Section 4.4</td>
</tr>
<tr>
<td>Week 5</td>
<td>Fourier Series</td>
<td>Sections 3.1 - 3.4</td>
</tr>
<tr>
<td>Week 6</td>
<td>Similarity Solutions</td>
<td>Sections 8.1 - 8.2</td>
</tr>
<tr>
<td>Week 7</td>
<td>Separation of Variables</td>
<td>Sections 4.1 - 4.2</td>
</tr>
<tr>
<td>Week 8</td>
<td>Separation of Variables</td>
<td>Sections 4.1 (cont.), 4.3</td>
</tr>
<tr>
<td>Week 9</td>
<td>Fourier Transforms</td>
<td>Sections 7.1 - 7.2</td>
</tr>
<tr>
<td>Week 10</td>
<td>Fourier Transforms</td>
<td>Section 7.3</td>
</tr>
<tr>
<td>Week 11</td>
<td>Green's Functions</td>
<td>Sections 6.1 - 6.2</td>
</tr>
<tr>
<td>Week 12</td>
<td>Green's Functions</td>
<td>Section 6.3</td>
</tr>
<tr>
<td>Week 13</td>
<td>Revision</td>
<td></td>
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Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policys.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released
directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe *academic integrity* – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues
- Student Advocacy provides independent advice on MQ policies, procedures, and
Student Enquiries
Got a question? Ask us via AskMQ, or contact Service Connect.

IT Help
For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Changes from Previous Offering
We value student feedback to be able to continually improve the way we offer our units. As such we encourage students to provide constructive feedback via student surveys, to the teaching staff directly, or via the FSE Student Experience & Feedback link in the iLearn page.

Student feedback from the previous offering of this unit was very positive overall, with students pleased with the clarity around assessment requirements and the level of support from teaching staff. As such, no change to the delivery of the unit is planned, however we will continue to strive to improve the level of support and the level of student engagement.