MATH336

Partial Differential Equations

S2 Day 2016

Dept of Mathematics

Contents

General Information

Unit convenor and teaching staff
Ji Li
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AHH L2
Monday 2:00--4:00pm

Leturer
Adam Tunney
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AHH L2
by appointment

Adam Tunney
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Credit points
3

Prerequisites
MATH235 and (MATH232 or MATH236)

Corequisites
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:

Knowledge of the principles and concepts of a basic theory of Partial Differential Equations

Ability to use the ideas and techniques of the theory of Partial Differential Equations to a model broad range of phenomena in science and and engineering (in particular using the heat and wave equations)

Understanding of the breadth of the theory of Partial Differential Equations and its role in other fields

Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning especially in the context of the theory of Partial Differential Equations

Demonstrate efficient use of Fourier analysis techniques in the theory of Partial Differential Equations

Preparing students to further studies in the areas of Partial Differential Equations and advance Analysis

Assessment Tasks

Name	Weighting	Due
3 Assignments	30%	week 4, wee 8, week 12
One Test	20%	week 9
Final exam	50%	Exam period

3 Assignments

Due: **week 4, wee 8, week 12**
Weighting: **30%**

Assessment

On successful completion you will be able to:

- Knowledge of the principles and concepts of a basic theory of Partial Differential Equations
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One Test

Due: **week 9**
Weighting: **20%**

Test will be held in class, for 1 hour.

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Final exam

Due: **Exam period**
Weighting: **50%**

final exam

On successful completion you will be able to:

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Delivery and Resources

Classes

Lectures: you should attend two hours of each lecture stream each week, making a total of four hours.

Required and Recommended Texts and/or Materials

No single textbook is entirely satisfactory for MATH336. The following texts provide useful references for various sections of the course:

- W. A. Strauss Partial Differential Equations, an introduction. Wiley 2008

Technology Used and Required

Students are expected to have access to an internet enabled computer with a web browser and Adobe Reader software. Several areas of the university provide wireless access for portable computers. There are computers for student use in the Library and in the Numeracy Centre (C5A 255).

Difficulties with your home computer or internet connection do not constitute a reasonable excuse for lateness of, or failure to submit, assessment tasks.

Unit Schedule

Week	A	B	

1	Introduction to PDE, rst order PDE $au_x + bu_y = 0$ methods: 1. characteristic lines, 2.changing of coordinates	Introductory modelling: flows, vibrations, and diusions.
2	first order PDE, general case $au_x+bu_y+cu = g(x; y)$, constant coecients, function coecients.	Initial and boundary conditions
3	second order linear PDE, general forms $Au_{xx} + Bu_{xy} + Cu_{yy} + Du_x + Eu_y + Fu = G$, and classications: 1. hyperbolic, 2. parabolic, 3. elliptic.	Waves equation with initial conditions: d'Alembert's methods.
4	second order linear PDE, canonical forms, and reduction of the general forms to canonical forms.	wave equation with initial conditions: energy methods.
5	boundary value problems for wave equations: 1. Dirichlet conditions, 2. Neumann conditions, 3. Robin conditions.	the diusion equation, maximal priciple, uniqueness, stability.
6	boundary value problems for heat equations: 1. Dirichlet conditions, 2. Neumann conditions, 3. Robin conditions.	the diusion equation on the whole line and half line.
7	Fourier series: coecients, even, odd, periodic functions, completeness, convergence.	reflection of waves: Dirichlet problem on the half-line, nite interval.
8	Inhomogeneous wave and heat equations.	diusion with a source: the inhomogeneous diusion equation on the whole line with initial conditions.
9	Laplace equations, maximal principle, fundamental solutions	wave with a source: inhomogeneous wave equation on the whole line with initial conditions
10	Laplace equations in specic domains: rectangles, disc, wedges, annuli	Finite-difference methods: explicit and implicit numerical schemes.
11	Laplace equations in general domains : Green's identity, Green's functions	Finite-difference methods: numerical stability, application to canonical equations.
12	Laplace equations in upper-half space: Green's identity, Green's functions	Advanced numerical methods: irregularly shaped domains, finite element method.
13	Revision	Revision

Learning and Teaching Activities

Lectures

There will be two, two hours long lectures per week. During these the content of the unit will be explained and example problems will be solved and applications in other disciplines discussed.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students

should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

New Assessment Policy in effect from Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Results

Results shown in *iLearn*, 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.

Student Support

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

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

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.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Knowledge of the principles and concepts of a basic theory of Partial Differential Equations
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- Demonstrate efficient use of Fourier analysis techniques in the theory of Partial Differential Equations
- Preparing students to further studies in the areas of Partial Differential Equations and advance Analysis

Assessment tasks

- 3 Assignments
- One Test
- Final exam

Learning and teaching activities

- There will be two, two hours long lectures per week. During these the content of the unit will be explained and example problems will be solved and applications in other disciplines discussed.

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

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Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

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Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

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Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate

and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

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Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

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Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

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Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

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Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

Learning outcomes

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Assessment tasks

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Learning and teaching activities

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Changes from Previous Offering

We now have 3 assignments, each contains both parts. In the past we have 8 assignments, with 4 in each part.