MATH331

Waves

S1 Day 2019

Dept of Mathematics and Statistics

Contents

General Information

Unit convenor and teaching staff
Unit Convenor & Lecturer
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See iLearn

Credit points
3

Prerequisites
MATH235 and (MATH232 or MATH236)

Corequisites

Co-badged status

Unit description
This unit introduces the theory of waves by a systematic study of the underlying partial differential equations. Waves involve the transfer, without bulk motion, of both energy and information. Fundamental properties of waves are first examined in the simplest one-dimensional setting. The treatment is then broadened to two-dimensional and three-dimensional waves, particularly for acoustic and electromagnetic waves. Resonators and waveguides provide some examples of how waves behave in confined regions. In contrast, the scattering and diffraction of waves by obstacles in free space carries information about the scatterer itself; this is the basis of many imaging technologies.

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:

Develop a good understanding and demonstrate knowledge of the basic methods and concepts of theory of wave equations and partial differential equations.
Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments especially in the context of the theory of wave equations. Be able to express

yourself clearly and logically in writing in this context.

Present a broad outline of the scope of theory of wave equations and their roles in mathematical modelling of physical phenomena.

Be able to apply the principles, concepts, and techniques learned in this unit to solve practical problems.

Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions and be able to formulate ideas using mathematical form.

Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in a mathematical context.

Be able to work effectively, responsibly and safely in an individual or team context.

General Assessment Information

LATE SUBMISSION OF WORK: All assignments must be submitted by the official due date and time. No marks will be given for late work unless an extension has been granted following a successful application for Special Consideration. Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines.

FINAL EXAM POLICY: You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is, the final day of the official examination period. The only excuse for not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these special circumstances, you may apply for special consideration via ask.mq.edu.au.

If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn (bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	15%	No	Week 4
Assignment 2	10%	No	Week 7

Name	Weighting	Hurdle	Due
Assignment 3	15%	No	Week 11
Final Exam	60%	Yes	Final Examination Period

Assignment 1

Due: **Week 4**
Weighting: **15%**

Assignment 1

On successful completion you will be able to:

- Develop a good understanding and demonstrate knowledge of the basic methods and concepts of theory of wave equations and partial differential equations.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments especially in the context of the theory of wave equations. Be able to express yourself clearly and logically in writing in this context.
- Present a broad outline of the scope of theory of wave equations and their roles in mathematical modelling of physical phenomena.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical problems.
- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions and be able to formulate ideas using mathematical form.
- Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in a mathematical context.
- Be able to work effectively, responsibly and safely in an individual or team context.

Assignment 2

Due: **Week 7**
Weighting: **10%**

Assignment 2

On successful completion you will be able to:

- Develop a good understanding and demonstrate knowledge of the basic methods and concepts of theory of wave equations and partial differential equations.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical

arguments especially in the context of the theory of wave equations. Be able to express yourself clearly and logically in writing in this context.
- Present a broad outline of the scope of theory of wave equations and their roles in mathematical modelling of physical phenomena.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical problems.
- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions and be able to formulate ideas using mathematical form.
- Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in a mathematical context.
- Be able to work effectively, responsibly and safely in an individual or team context.

Assignment 3

Due: **Week 11**
Weighting: **15%**

Assignment 3

On successful completion you will be able to:

- Develop a good understanding and demonstrate knowledge of the basic methods and concepts of theory of wave equations and partial differential equations.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments especially in the context of the theory of wave equations. Be able to express yourself clearly and logically in writing in this context.
- Present a broad outline of the scope of theory of wave equations and their roles in mathematical modelling of physical phenomena.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical problems.
- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions and be able to formulate ideas using mathematical form.
- Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in a mathematical context.
- Be able to work effectively, responsibly and safely in an individual or team context.

Final Exam

Due: **Final Examination Period**
Weighting: **60%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Final Exam

Minimum result of 50% in the Final Exam is required to pass this unit.

On successful completion you will be able to:

- Develop a good understanding and demonstrate knowledge of the basic methods and concepts of theory of wave equations and partial differential equations.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments especially in the context of the theory of wave equations. Be able to express yourself clearly and logically in writing in this context.
- Present a broad outline of the scope of theory of wave equations and their roles in mathematical modelling of physical phenomena.
- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions and be able to formulate ideas using mathematical form.

Delivery and Resources

Classes

There will be three formal contact hours per week, consisting of three lectures. Each second week, beginning in week 2, one of these lectures will be replaced by a small group teaching activity (SGTA). Details of these will be announced in iLearn.

It is vital for your learning in this unit that you attend all lectures and actively engage in all SGTA's.

Recommended Texts

Although there is not single textbook that will cover the unit, the following text is a very useful reference:

- J. Billingham & A. C. King, *Wave Motion*, Cambridge University Press, 2000.

Unit Schedule

Small-amplitude (linear) waves:

- waves on a stretched string
- sound waves
- water waves
- electromagnetic waves
- earthquakes

Nonlinear waves

- traffic flow
- chemical waves
- detonation of a gas

Mathematical features of waves

- transmission and reflection of waves at interfaces
- wave propagation
- shock waves
- solitary waves (solitons)

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). 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
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the

key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/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/study/getting-started/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

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

If you are a Global MBA student contact globalmba.support@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

- Develop a good understanding and demonstrate knowledge of the basic methods and concepts of theory of wave equations and partial differential equations.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical problems.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Final Exam

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.

This graduate capability is supported by:

Learning outcomes

- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions and be able to formulate ideas using mathematical form.
- Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in a mathematical context.
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Assessment tasks

- Assignment 1
- Assignment 2

- Assignment 3

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.

This graduate capability is supported by:

Learning outcomes

- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical problems.
- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions and be able to formulate ideas using mathematical form.
- Be able to work effectively, responsibly and safely in an individual or team context.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3

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.

This graduate capability is supported by:

Learning outcomes

- Develop a good understanding and demonstrate knowledge of the basic methods and concepts of theory of wave equations and partial differential equations.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments especially in the context of the theory of wave equations. Be able to express yourself clearly and logically in writing in this context.
- Present a broad outline of the scope of theory of wave equations and their roles in

mathematical modelling of physical phenomena.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Final Exam

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.

This graduate capability is supported by:

Learning outcomes

- Develop a good understanding and demonstrate knowledge of the basic methods and concepts of theory of wave equations and partial differential equations.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments especially in the context of the theory of wave equations. Be able to express yourself clearly and logically in writing in this context.
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Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Final Exam

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.

This graduate capability is supported by:

Learning outcomes

- Develop a good understanding and demonstrate knowledge of the basic methods and concepts of theory of wave equations and partial differential equations.
- Present a broad outline of the scope of theory of wave equations and their roles in mathematical modelling of physical phenomena.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical problems.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
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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.

This graduate capability is supported by:

Learning outcomes

- Develop a good understanding and demonstrate knowledge of the basic methods and concepts of theory of wave equations and partial differential equations.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments especially in the context of the theory of wave equations. Be able to express yourself clearly and logically in writing in this context.
- Present a broad outline of the scope of theory of wave equations and their roles in mathematical modelling of physical phenomena.
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Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Final Exam

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.

This graduate capability is supported by:

Learning outcome

- Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in a mathematical context.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3