



MATH232

Mathematical Techniques

S2 Day 2019

Dept of Mathematics and Statistics

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General Information

Unit convenor and teaching staff

Lecturer/Convenor

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Contact via Email

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See iLearn for consultation hours

Frank Schoenig

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Credit points

3

Prerequisites

MATH133 or MATH136

Corequisites

Co-badged status

Unit description

This unit develops techniques and skills that are fundamental in the study and application of mathematics at an advanced level. In any successful application, two contrasting but complementary skills must be developed: the ability to formulate a given real-world problem in appropriate mathematical terms; and sufficient knowledge to obtain useful information and testable predictions from that model, by analytical and numerical means. The unit shows how differential equations arise as mathematical models of such real phenomena in science, engineering and the social sciences, and introduces some tools including Fourier series for the study and eventual solution of these equations. Maps arising from discrete time models are also introduced. Fourier series and transforms are particularly useful in those situations where the system response (and indeed many functions) can be seen as a complex sum of simpler vibrations or oscillations. Numerical techniques are briefly discussed; they are essential when analytical methods fail, or provide only limited information about the model.

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:

Demonstrate knowledge of the principles and concepts of mathematical modelling and Fourier series.

Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.

Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.

Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

General Assessment Information

HURDLES: This unit has no hurdle requirements.

ATTENDANCE and PARTICIPATION: Please contact the unit convenor as soon as possible if you have difficulty attending and participating in any classes. There may be alternatives available to make up the work. If there are circumstances that mean you miss a class, you can apply for a [Special Consideration](#).

ASSIGNMENT SUBMISSION: Assignment submission will be online through the iLearn page. The following information is also available on the iLearn page:

Submit assignments online via the appropriate assignment link on the iLearn page. A personalised cover sheet is not required with online submissions. Read the submission statement carefully before accepting it as there are substantial penalties for making a false declaration.

- Assignment submission is via iLearn. You should upload this as a single scanned PDF file.
- Please note the quick guide on how to upload your assignments in the link above.
- Please make sure that each page in your uploaded assignment corresponds to only one A4 page (do not upload an A3 page worth of content as an A4 page in landscape). If you are using an app like Clear Scanner, please make sure that the photos you are using are clear and shadow-free.
- It is your responsibility to make sure your assignment submission is legible.
- If there are technical obstructions to your submitting online, please email us to let us know.

You may submit as often as required prior to the due date/time. Please note that each submission will completely replace any previous submissions. It is in your interests to make frequent submissions of your partially completed work as insurance against technical or other problems near the submission deadline.

LATE SUBMISSION OF WORK: All assignments or assessments must be submitted by the

official due date and time. No marks will be given to 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. It is in your interests to make frequent submissions of your partially completed work. Note that later submissions completely replace any earlier submission, and so only the final submission made before the due date will be marked.

FINAL EXAM POLICY: 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.

SUPPLEMENTARY EXAMINATIONS:

IMPORTANT: 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. If you apply for special consideration, you must give the supplementary examination priority over any other pre-existing commitments, as such commitments will not usually be considered an acceptable basis for a second application for special consideration. 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 (<https://bit.ly/FSESupp>) for dates, and approved applicants will receive an individual notification sometime in the week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
One Test	20%	No	see iLearn
Two assignments	40%	No	see iLearn
Final examination	40%	No	University Examination Period

One Test

Due: **see iLearn**

Weighting: **20%**

Supervised in class 1 hour test

On successful completion you will be able to:

- Demonstrate knowledge of the principles and concepts of mathematical modelling and Fourier series.
- Demonstrate understanding of the role of mathematics in other disciplines and the way

other disciplines contribute to the development of the mathematical sciences.

- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.
- Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

Two assignments

Due: **see iLearn**

Weighting: **40%**

Assignments on Modelling and Fourier Analysis

On successful completion you will be able to:

- Demonstrate knowledge of the principles and concepts of mathematical modelling and Fourier series.
- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.
- Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

Final examination

Due: **University Examination Period**

Weighting: **40%**

Final examination

On successful completion you will be able to:

- Demonstrate knowledge of the principles and concepts of mathematical modelling and Fourier series.
- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.
- Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

Delivery and Resources

Classes

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

Small Group Teaching Activity (SGTA): you should attend one SGTA each week, starting in week 2.

Required and Recommended Texts and/or Materials

A set of online notes is available on iLearn.

The online notes are intended primarily as a source of reference. These are not intended to be treated as the only source for learning.

The following texts provide useful references for various sections of the course

- A. Pinkus & S. Zafrany, *Fourier Series and Integral Transforms*, Cambridge University Press, 1997. (QA404.P56 1997)
- E. Kreyszig, *Advanced Engineering Mathematics*, Wiley (several editions) (QA401.K7)
- F. B. Hildebrand, *Advanced Calculus for Applications*, Prentice-Hall, 1962 (QA303.H55)
- R. Knobel, R. *An introduction to the mathematical theory of waves*, American Mathematical Society, 1999 (QA927.K963/1999).
- G. Fulford, P. Forrester & A. Jones, *Modelling with Differential and Difference Equations/ $i>$* , Cambridge University Press, 1997 (QA401.F85)
- G. D. Smith, *Numerical Solution of Partial Differential Equations*, Oxford University Press, 2nd /3rd Edition (QA374.S56/1978, 1985)
- K.K. Tung, *Topics in Mathematical Modelling*, Princeton University Press, 2007.

Other similar texts are available in the Library.

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.

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

The following table gives an approximate timetable for the topics covered week-by-week

Week	Fourier Analysis	Modelling	Task due
1	Series of functions, inner products, Fourier series	Introduction to modelling	
2	Fourier series, ctd.	Modelling with ODEs	
3	Fourier series: Bessel's inequality	Models from biology, physics...	
4	Fourier series: convergence	Models from biology, physics...	
5	Fourier series: differentiation and integration	Models from biology, physics...	
6	Integration, ctd. Sine, cosine series.	ODEs and phase plane	Assignment 1, Tuesday 11pm
7	Fourier series on general intervals.	Modelling with PDEs	
8	Application to PDEs. Separation of variables	Heat and diffusion: PDE models	Test, Thursday 3rd October
9	Fourier transform	Waves and potentials: PDE models	
10	Inverse Fourier transform	Modelling with maps	
11	Inverse Fourier transform, ctd.	The logistic map	
12	Fourier transforms: application to solving PDEs	Numerical methods for ODEs	Assignment 2, Tuesday 11pm
13	Revision	Revision	

Learning and Teaching Activities

Lectures

There will be 2 two-hour lectures per week, where the concepts are introduced, explained and illustrated. During these the content of the unit will be explained and example problems will be solved and applications in other disciplines discussed.

Small Group Teaching Activity (SGTA)

There will be a one hour SGTA per week. The SGTA questions will be available on iLearn by the end of the previous week. A set of model answers for the SGTA questions will be posted on iLearn at the end of each week.

Assignments

There will be two assignments in this unit to be submitted online via iLearn. Assignment questions will be made available on iLearn after the material required to answer them has been covered in lectures and at least two weeks before the due date. While we encourage collaborative learning, these are individual assignments, and the work you submit must be your own work. For your own protection, we advise all students participating in group study sessions related to assignment questions to ensure that all participants in such groups destroy any notes they have made at the end of such a session. Participants can then independently construct their own solutions based on the understanding and insight provided by the study session without running the risk of breaching the rules relating to academic misconduct

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) (<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) (<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) (<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

- Demonstrate knowledge of the principles and concepts of mathematical modelling and Fourier series.

- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.
- Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

Assessment tasks

- One Test
- Two assignments
- Final examination

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 knowledge of the principles and concepts of mathematical modelling and Fourier series.
- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.
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Assessment tasks

- One Test
- Two assignments
- Final examination

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

- Demonstrate knowledge of the principles and concepts of mathematical modelling and Fourier series.
- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.
- Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

Assessment tasks

- One Test
- Two assignments
- Final examination

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

- Demonstrate knowledge of the principles and concepts of mathematical modelling and Fourier series.
- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.
- Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

Assessment tasks

- One Test
- Two assignments
- Final examination

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

- Demonstrate knowledge of the principles and concepts of mathematical modelling and Fourier series.
- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.
- Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

Assessment tasks

- One Test
- Two assignments
- Final examination

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

- Demonstrate knowledge of the principles and concepts of mathematical modelling and Fourier series.

- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.
- Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

Assessment tasks

- One Test
- Two assignments
- Final examination

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

- Demonstrate knowledge of the principles and concepts of mathematical modelling and Fourier series.
- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods.
- Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

Assessment tasks

- One Test
- Two assignments
- Final examination

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 outcomes

- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.
- Apply mathematical principles, concepts, techniques and technology to solve practical and abstract problems.

Assessment task

- Two assignments

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 outcome

- Demonstrate understanding of the role of mathematics in other disciplines and the way other disciplines contribute to the development of the mathematical sciences.

Assessment task

- Two assignments