UNSW Course Outline

MATH2221 Higher Theory and Applications of Differential Equations - 2024

Published on the 13 May 2024

General Course Information

Course Code : MATH2221
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Science
Academic Unit : School of Mathematics & Statistics
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course builds on students' studies on first-order ordinary and second order ordinary

differential equations with constant coefficients from their first-year mathematics courses. In this course, students explore second-order ordinary differential equations with variable coefficients and, in addition, are introduced to partial differential equations. An investigation of boundary value problems is conducted, and these problems are contrasted with the initial value problems. Not all differential equations can be solved in terms of known functions such as polynomials and exponentials and the like. At the completion of the course, students will understand how to get information about the solution in these cases using power series methods and the Frobenius method. They will also understand how to find solutions to boundary value problems in 1D using Sturm-Liouville methods and Fourier series methods, and find solutions to boundary value problems in 2D using Elliptic differential operators, Green identities, Elliptic eigenproblems and Wave and diffusion equations.

This course is a prerequisite for the third year courses MATH3121 Mathematical Methods and Partial Differential Equations, MATH3120 Dynamical Systems and Chaos, and MATH3261 Fluids, Oceans and Climates.

All content of MATH2121 is common to MATH2221, but presented in greater depth, and with some additional topics. Instruction consists of four hours of lecture per week together with one hour of tutorial per week. Both lecture and tutorial instruction are delivered face-to-face.

Course Aims

The aim of this course is to build on students' previous study of ordinary differential equations (ODEs) as part of first-year calculus. The course is designed to deepen students' developing problem solving skills by broadening their exposure to range of differential equation and expand their repertoire of methods for interrogating and finding a solution to various differential equations. Although the focus of the course is on analytical methods of solution, a variety of applications that give rise to differential equation models are also discussed.

Relationship to Other Courses

Prerequisite: MATH1231 or MATH1241 or MATH1251 or DPST1014, each with a mark of 70 or higher.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Characterise a wide range of ordinary and partial differential equations and the solution methods appropriate to them.
CLO2 : Determine whether solutions to a range of initial value problems and boundary value problems for differential equations exist and are unique.
CLO3 : Apply a range of methods to find solutions to differential equations. These methods may include separation of variables, series solutions, eigenvector methods, and other solutions methodologies that can provide exact solutions.
CLO4 : Apply the concept of linear superposition to solve a range of single and multidimensional boundary value problems.

Course Learning Outcomes	Assessment Item
CLO1 : Characterise a wide range of ordinary and partial differential equations and the solution methods appropriate to them.	• Class Test 1 • Class Test 2 • Final Exam
CLO2 : Determine whether solutions to a range of initial value problems and boundary value problems for differential equations exist and are unique.	• Class Test 1 • Class Test 2 • Final Exam
CLO3 : Apply a range of methods to find solutions to differential equations. These methods may include separation of variables, series solutions, eigenvector methods, and other solutions methodologies that can provide exact solutions.	• Class Test 1 • Class Test 2 • Final Exam
CLO4 : Apply the concept of linear superposition to solve a range of single and multidimensional boundary value problems.	• Class Test 2 • Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System | Blackboard Collaborate | Zoom | Echo 360

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Class Test 1 Assessment Format: Individual	20%	Start Date: Given during Week 5 tutorial Due Date: At the end of the student's Week 5 tutorial
Class Test 2 Assessment Format: Individual	20%	Start Date: Week 9 Tutorial Due Date: At the conclusion of the student's Week 9 Tutorial
Final Exam Assessment Format: Individual	60%	

Assessment Details

Class Test 1

Assessment Overview

Class Test 1 is designed as a summative assessment of the learning outcomes assesses for the topics covered in weeks 1-4, inclusive (lecture material only). Class Test 1 will typically be scheduled in week 5 as a single attempt with a time limit of 60 minutes. The test consists of short answer questions only, in which you will be expected to show all details of your solutions. The precise format of the test will be confirmed during the course. Feedback will be provided through the gradebook to link incorrect answers to topic learning outcomes and via a generalised class feedback discussion in lectures.

Course Learning Outcomes

- CLO1 : Characterise a wide range of ordinary and partial differential equations and the solution methods appropriate to them.
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Detailed Assessment Description

Class Test 1 is designed as a summative assessment of the learning outcomes assesses for the topics covered in weeks 1-4, inclusive (lecture material only). Class Test 1 will typically be scheduled in week 5 as a single attempt with a time limit of 60 minutes. The test consists of short answer questions only, in which you will be expected to show all details of your solutions.

The precise format of the test will be confirmed during the course. Feedback will be provided through the gradebook to link incorrect answers to topic learning outcomes and via a generalised class feedback discussion in lectures.

Assessment Length

60 minutes

Assignment submission Turnitin type

Not Applicable

Class Test 2

Assessment Overview

Class Test 2 is designed as a summative assessment of the learning outcomes assesses for the topics covered in weeks 5, 7, and 8 (lecture material only). Class Test 2 will typically be scheduled in week 9 as a single attempt with a time limit of 60 minutes. The test consists of short answer questions only, in which you will be expected to show all details of your solutions; the precise format of the test will be confirmed during the course. Feedback will be provided through the gradebook to link incorrect answers to topic learning outcomes and via a generalised class feedback discussion in lectures.

Course Learning Outcomes

- CLO1 : Characterise a wide range of ordinary and partial differential equations and the solution methods appropriate to them.
- CLO2 : Determine whether solutions to a range of initial value problems and boundary value problems for differential equations exist and are unique.
- CLO3 : Apply a range of methods to find solutions to differential equations. These methods may include separation of variables, series solutions, eigenvector methods, and other solutions methodologies that can provide exact solutions.
- CLO4 : Apply the concept of linear superposition to solve a range of single and multidimensional boundary value problems.

Detailed Assessment Description

Class Test 2 is designed as a summative assessment of the learning outcomes assesses for the topics covered in weeks 5, 7, and 8 (lecture material only). Class Test 2 will typically be scheduled in week 9 as a single attempt with a time limit of 60 minutes. The test consists of short answer questions only, in which you will be expected to show all details of your solutions; the precise format of the test will be confirmed during the course. Feedback will be provided through the gradebook to link incorrect answers to topic learning outcomes and via a generalised class feedback discussion in lectures.

Assessment Length

60 minutes

Assignment submission Turnitin type

Not Applicable

Final Exam

Assessment Overview

The final exam is the major assessment task. It will last for 2 hours. You will be expected to demonstrate mastery of both the theoretical and computational course material. The exam will be formatted as four, multi-part free response questions, in which you will be expected to show all details of your solutions. The exam will occur during the formal examination period.

Feedback is available through inquiry with the course convenor.

Course Learning Outcomes

- CLO1 : Characterise a wide range of ordinary and partial differential equations and the solution methods appropriate to them.
- CLO2 : Determine whether solutions to a range of initial value problems and boundary value problems for differential equations exist and are unique.
- CLO3 : Apply a range of methods to find solutions to differential equations. These methods may include separation of variables, series solutions, eigenvector methods, and other solutions methodologies that can provide exact solutions.
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Detailed Assessment Description

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Feedback is available through inquiry with the course convenor.

Assessment Length

180 minutes

Assignment submission Turnitin type

Not Applicable

General Assessment Information

Grading Basis

Standard

Requirements to pass course

Achieve a composite mark of 50 out of 100

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Module	Introduction to linear ordinary differential equations (ODEs)
Week 2 : 3 June - 9 June	Module	Inhomogeneous ODEs and power series methods
Week 3 : 10 June - 16 June	Module	Singular ODEs
Week 4 : 17 June - 23 June	Module	Dynamical systems
Week 5 : 24 June - 30 June	Module	Initial-boundary value problems in 1D
Week 6 : 1 July - 7 July	Module	Flexibility Week
Week 7 : 8 July - 14 July	Module	Partial differential equations (PDEs) and orthogonal systems
Week 8 : 15 July - 21 July	Module	Generalised Fourier series
Week 9 : 22 July - 28 July	Module	Initial-boundary problems in 2D
Week 10 : 29 July - 4 August	Module	Applications to 2D and 3D problems

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Resources

Prescribed Resources

There are no required textbooks.

Recommended Resources

Zill, Dennis G. Differential equations with boundary-value problems. Nelson Education, 2016.

Additional Costs

None.

Course Evaluation and Development

Student feedback is gathered at the end of the course, and it is used to inform future iterations of the course. For example, student feedback regarding the course pacing might affect how quickly topics are introduced in the future.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
	Chris Goodrich					No	Yes

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the UNSW Student Code of Conduct Website.

Academic Honesty and Plagarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.
Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.
Further information about academic integrity, plagiarism and the use of AI in assessments can

be located at:

- The Current Students site,
- The ELISE training site, and
- The Use of AI for assessments site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: https://student.unsw.edu.au/special-consideration

Important note: UNSW has a "fit to sit/submit" rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination

or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- The Current Students Gateway
- Student Support
- Academic Skills and Support
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- UNSW IT Service Centre
- Science EDI Student Initiatives, Offerings and Guidelines

School-specific Information

School of Mathematics and Statistics and UNSW Policies

The School of Mathematics and Statistics has adopted a number of policies relating to enrolment, attendance, assessment, plagiarism, cheating, special consideration etc. These are in addition to the Policies of The University of New South Wales. Individual courses may also adopt other policies in addition to or replacing some of the School ones. These will be clearly notified in the Course Initial Handout and on the Course Home Pages on the Maths Stats web site. Students in courses run by the School of Mathematics and Statistics should be aware of the School and Course policies by reading the appropriate pages on the web site starting at: The School of Mathematics and Statistics assessment policies

The School of Mathematics and Statistics will assume that all its students have read and understood the School policies on the above pages and any individual course policies on the Course Initial Handout and Course Home Page. Lack of knowledge about a policy will not be an excuse for failing to follow the procedure in it.

Special Consideration - Short Extension Policy

The School of Mathematics and Statistics has carefully reviewed its range of assignments and projects to determine their suitability for automatic short extensions as set out by the UNSW Short Extension Policy. Upon comprehensive examination of our course offerings that incorporate these types of assessments, we have concluded that our current deadline structures

already accommodate the possibility of unexpected circumstances that may lead students to require additional days for submission. Consequently, the School of Mathematics and Statistics has decided to universally opt out of the Short Extension provision for all its courses, having pre-emptively integrated flexibility into our assessment deadlines. The decision is subject to revision in response to the introduction of new course offerings. Students may still apply for Special Consideration via the usual procedures.

Computing Lab

The main computing laboratory is room G012 of the Anita B.Lawrence Centre (formerly Red Centre). You can get to this lab by entering the building through the main entrance to the School of Mathematics (on the Mezzanine Level) and then going down the stairs to the Ground Level. A second smaller lab is Room M020, located on the mezzanine level through the glass door (and along the corridor) opposite the School's entrance.

For more information, including opening hours, see the computing facilities webpage. Remember that there will always be unscheduled periods when the computers are not working because of equipment problems and that this is not a valid excuse for not completing assessments on time.

School Contact Information

Please visit the School of Mathematics and Statistics website for a range of information.

For information on Courses, please go to “Student life & resources” and either Undergraduate and/or Postgraduate and respective "Undergraduate courses" and "Postgraduate courses" for information on all course offerings.

All school policies, forms and help for students can be located by going to the "Student Services" within “Student life & resources” page. We also post notices in "Student noticeboard" for your information. Please familiarise yourself with the information found in these locations. If you cannot find the answer to your queries on the web you are welcome to contact the Student Services Office directly.

Undergraduate

E: ug.mathsstats@unsw.edu.au

P: 9385 7011 or 9385 7053

Postgraduate

E: pg.mathsstats@unsw.edu.au

P: 9385 7053

Should we need to contact you, we will use your official UNSW email address of in the first instance. **It is your responsibility to regularly check your university email account. Please use your UNSW student email and state your student number in all emails to us.**