UNSW Course Outline

MATH2121 Theory and Applications of Differential Equations - 2024

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General Course Information

Course Code : MATH2121
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 elementary knowledge of differential equations (taught in MATH1231 at

UNSW) to provide further theory and methods for solving ordinary differential equations and partial differential equations with illustrative applications in physics, engineering, and biology.

The specific topics for ordinary differential equations include: first order, linear second order, variation of parameters, dynamical systems, power series representations and Frobenius method, orthogonal functions and Fourier series, initial and boundary value problems, eigenfunction expansions, Bessel's equation.
For partial differential equations, topics include: classification, method of separation of variables, application of Fourier series, heat equation, wave equation, Laplace's equation, applications of Bessel functions.

Tutorials are designed to reinforce the techniques taught in lectures for solving differential equations.

Course Aims

The overall aim of this course is to further develop students' skills in solving differential equations. This is done by learning how to approach solving second order ordinary differential equations with variable coefficients and giving an introduction to partial differential equations.

A major aim of this course is to teach students how to obtain information about the solution using power series methods and Frobenius' method in cases where the differential equations cannot be solved in terms of "elementary" functions such as polynomials, exponentials or trigonometric functions.

A second major aim is to learn how to find solutions to boundary value problems using Sturm-Liouville methods and Fourier series methods.

Relationship to Other Courses

Prerequisite: MATH1231 or MATH1241 or MATH1251 or DPST1014

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Recall and apply fundamental methods for solving ordinary differential equations, including power series and Frobenius' methods.
CLO2 : Solve systems of linear ordinary differential equations, classify equilibrium points, and sketch phase portraits.
CLO3 : Analyse functions, their periodic extension, odd and even extensions using Fourier Series methods.
CLO4 : Solve partial differential equations using the method of separation of variables.

Course Learning Outcomes	Assessment Item
CLO1 : Recall and apply fundamental methods for solving ordinary differential equations, including power series and Frobenius' methods.	• Class Test 1 • Class Test 2 • Final Exam
CLO2 : Solve systems of linear ordinary differential equations, classify equilibrium points, and sketch phase portraits.	• Class Test 2 • Final Exam
CLO3 : Analyse functions, their periodic extension, odd and even extensions using Fourier Series methods.	• Final Exam
CLO4 : Solve partial differential equations using the method of separation of variables.	• Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Class Test 1 Assessment Format: Individual	20%	Start Date: Not Applicable Due Date: Week 4
Class Test 2 Assessment Format: Individual	20%	Start Date: Not Applicable Due Date: Week 7
Final Exam Assessment Format: Individual	60%	Start Date: Not Applicable Due Date: Exam Period

Assessment Details

Class Test 1

Assessment Overview

Class test 1 is designed to assess your knowledge of pre-requisite and contents covered in weeks 1 and 2.

Class test 1 will be typically scheduled in week 4 with a time limit of 45 minutes.

You will be provided with sample tests and solutions.

Course Learning Outcomes

- CLO1 : Recall and apply fundamental methods for solving ordinary differential equations, including power series and Frobenius' methods.

Detailed Assessment Description

Class test 1 is designed to assess your knowledge of pre-requisite content and content covered in weeks 1 and 2.

Class test 1 will be typically scheduled in week 4 with a time limit of 45 minutes.

You will be provided with sample tests and solutions.

Assignment submission Turnitin type

Not Applicable

Class Test 2

Assessment Overview

Class test 2 is designed to assess your knowledge of contents covered in weeks 3 through 5.

Class test 2 will be typically scheduled in week 7 with a time limit of 45 minutes.

You will be provided with sample tests and solutions.

Course Learning Outcomes

- CLO1 : Recall and apply fundamental methods for solving ordinary differential equations, including power series and Frobenius' methods.
- CLO2 : Solve systems of linear ordinary differential equations, classify equilibrium points, and sketch phase portraits.

Detailed Assessment Description

Class test 2 is designed to assess your knowledge of content covered in weeks 3 through 5.

Class test 2 will be typically scheduled in week 7 with a time limit of 45 minutes.

You will be provided with sample tests and solutions.

Assignment submission Turnitin type

Not Applicable

Final Exam

Assessment Overview

The final exam covers the content of the entire course. It is designed to summarise your learning and problem-solving skills on all topics delivered across all weeks of the term, including materials from lectures and tutorials. The exam is typically 2 hours.

The examination will occur during the official university examination period.

Course Learning Outcomes

- CLO1 : Recall and apply fundamental methods for solving ordinary differential equations, including power series and Frobenius' methods.
- CLO2 : Solve systems of linear ordinary differential equations, classify equilibrium points, and sketch phase portraits.
- CLO3 : Analyse functions, their periodic extension, odd and even extensions using Fourier Series methods.
- CLO4 : Solve partial differential equations using the method of separation of variables.

Detailed Assessment Description

The final exam covers the content of the entire course. It is designed to summarise your learning and problem-solving skills on all topics delivered across all weeks of the term, including material from lectures and tutorials. The exam is typically 2 hours.

The examination will occur during the official university examination period.

Assignment submission Turnitin type

Not Applicable

General Assessment Information

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Lecture	First order ordinary differential equations (ODEs)
Week 2 : 3 June - 9 June	Lecture	Second order ODEs
Week 3 : 10 June - 16 June	Lecture	Power series and Frobenius' method
Week 4 : 17 June - 23 June	Lecture	Power series and Frobenius' method, Systems of ODEs
Week 5 : 24 June - 30 June	Lecture	Systems of ODEs
Week 6 : 1 July - 7 July	Homework	Flexibility week.
Week 7 : 8 July - 14 July	Lecture	Orthogonal functions and Fourier series
Week 8 : 15 July - 21 July	Lecture	Boundary value problems for homogeneous linear second order ODEs
Week 9 : 22 July - 28 July	Lecture	Partial differential equations (PDEs)
Week 10 : 29 July - 4 August	Lecture	Partial differential equations (PDEs)

Attendance Requirements

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

Course Resources

Recommended Resources

W. E. Boyce and R. C. DiPrima: Elementary Differential Equations and Boundary Value Problems. (Wiley, 2009).

W. R. Derrick and S. I. Grossman: Introduction to Differential Equations with Boundary Value Problems. (West Publishing, 1987).

E. Kreyszig: Advanced Engineering Mathematics. (Wiley, 1999).

R. K. Nagle and E. B. Saff: Fundamentals of Differential Equations and Boundary Value Problems. (Addison-Wesley, 1996).

A. Rabenstein: Introduction to Ordinary Differential Equations. (Academic Press, 1972).

M. Spiegel: Advanced Mathematics for Engineers and Scientists. (Schaum Outline Series, 1983).

D. G. Zill: Differential Equations with Boundary-Value Problems. (PWS-KENT, 1989).

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Jim Pettigrew		Anita B. Lawrence Centre, Room 3091		Monday to Friday	No	Yes
Lecturer	Anna Cai		Anita B. Lawrence Centre, Room 2083	9385 7039	Monday to Friday	No	No

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.**