UNSW Course Outline

MATH3201 Dynamical Systems and Chaos - 2024

Published on the 02 Sep 2024

General Course Information

Course Code : MATH3201
Year : 2024
Term : Term 3
Teaching Period : T3
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

Many nonlinear systems do not have explicit solutions. The dynamical systems approach shifts the focus from finding explicit solutions to discovering geometric properties of solutions. It also recognises that even a small amount of nonlinearity in a physical system can be responsible for

very complicated chaotic behaviour. During lectures and tutorials, students will learn the fundamentals of dynamical systems in discrete-time maps and continuous-time ODEs, allowing them to analyse the local and global behaviour of dynamical systems. Students will also learn how to analyse time series data using nonlinear tools and build appropriate predictive model.

Course Aims

This course is designed to introduce students to the fundamentals of dynamical systems in discrete-time maps and continuous-time ODEs, allowing them to analyse the local and global behaviour of dynamical systems. Students will also learn how to analyse time series data using nonlinear tools and build appropriate predictive models.

Relationship to Other Courses

Prerequisite: (MATH2501 or MATH2601 or MATH2089 or MATH2099) and (MATH2011 or MATH2111 or MATH2018 (DN) or MATH2019 (DN) or MATH2069 (CR) or MATH2121 or MATH2221)

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Model and analyse complex dynamical phenomena.
CLO2 : Demonstrate the connections between dynamical systems and other mathematics subjects.
CLO3 : Solve various problems in dynamical systems.
CLO4 : Communicate mathematics competently in a written form.

Course Learning Outcomes	Assessment Item
CLO1 : Model and analyse complex dynamical phenomena.	• Project 1 • Project 2 • Final Examination
CLO2 : Demonstrate the connections between dynamical systems and other mathematics subjects.	• Project 1 • Project 2 • Final Examination
CLO3 : Solve various problems in dynamical systems.	• Project 1 • Project 2 • Final Examination
CLO4 : Communicate mathematics competently in a written form.	• Project 1 • Project 2 • Final Examination

Learning and Teaching Technologies

Moodle - Learning Management System

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Project 1 Assessment Format: Group	20%	Start Date: Week 3 Due Date: Week 6
Project 2 Assessment Format: Group	20%	Start Date: Week 7 Due Date: Week 9
Final Examination Assessment Format: Individual	60%	Start Date: During the exam period Due Date: During the exam period

Assessment Details

Project 1

Assessment Overview

You will complete a Project task that focuses on the first third of the content delivered in the course. The purpose is to ensure that all students are progressing well with the course.

The task will be available from Week 3 and is due in Week 6. Feedback will be provided to you within one week.

75% of the grade is based on your group performance and 25% on individual performance.

Course Learning Outcomes

- CLO1 : Model and analyse complex dynamical phenomena.
- CLO2 : Demonstrate the connections between dynamical systems and other mathematics subjects.
- CLO3 : Solve various problems in dynamical systems.
- CLO4 : Communicate mathematics competently in a written form.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing

functions in the software you use to complete your assessment. These functions are described below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.
If your Convenor has concerns that your submission contains passages of AI-generated text or media, you may be asked to account for your work. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.
For more information on Generative AI and permitted use please see here.

Project 2

Assessment Overview

You will complete a Project task that focuses on the second third of content delivered in the course. The purpose is to ensure that all students are progressing well with the course.

The task will be available from Week 7 and is due in Week 9. Feedback will be provided to you within one week.

75% of the grade is based on your group performance and 25% on individual performance.

Course Learning Outcomes

- CLO1 : Model and analyse complex dynamical phenomena.
- CLO2 : Demonstrate the connections between dynamical systems and other mathematics subjects.
- CLO3 : Solve various problems in dynamical systems.
- CLO4 : Communicate mathematics competently in a written form.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing functions in the software you use to complete your assessment. These functions are described below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.
If your Convenor has concerns that your submission contains passages of AI-generated text or media, you may be asked to account for your work. If you are unable to satisfactorily

demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.
For more information on Generative AI and permitted use please see here.

Final Examination

Assessment Overview

You will complete a 2 hour final exam during the formal exam period. The exam is designed to summarise your learning and problem-solving skills on all topics delivered across the term, including material from lectures, tutorials and workshops.
Feedback is available through inquiry with the course convenor.

Course Learning Outcomes

- CLO1 : Model and analyse complex dynamical phenomena.
- CLO2 : Demonstrate the connections between dynamical systems and other mathematics subjects.
- CLO3 : Solve various problems in dynamical systems.
- CLO4 : Communicate mathematics competently in a written form.

Assessment Length

Two (2) hours

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

Not Applicable

Generative AI is not considered to be of assistance to you in completing this assessment. If you do use generative AI in completing this assessment, you should attribute its use.
For more information on Generative AI and permitted use please see here.

General Assessment Information

No late submissions accepted past the deadline.

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 0 : 2 September - 8 September	Other	General orientation week, no lectures or tutorials.
Week 1 : 9 September - 15 September	Lecture	Introduction to dynamical systems and chaos, including history, general concepts and methods. Discrete-time dynamical systems in one dimension, including disussion of stability and graphical analysis.
Week 2 : 16 September - 22 September	Lecture	Further discussion of discrete-time dynamical systems in one dimension, focussing on linearisation, Lyapunov exponents and topological conjugacy.
Week 3 : 23 September - 29 September	Lecture	Characterising chaos by reference to transitivity, sensitive dependence on initial conditions and dense sets of periodic points. Exploration of examples involving circle maps and symbolic dynamics.
Week 4 : 30 September - 6 October	Lecture	Bifurcation theory. Discrete-time dynamical systems in multiple dimensions: linear dynamics.
Week 5 : 7 October - 13 October	Lecture	Strange attractors, stable and unstable manifolds.
Week 6 : 14 October - 20 October	Other	Flexibility week
Week 7 : 21 October - 27 October	Lecture	Continuous-time dynamical systems in multiple dimensions: linear dynamics, including discussion of stability.
Week 8 : 28 October - 3 November	Lecture	Continuous-time dynamical systems in multiple dimensions: nonlinear dynamics, including discussion of stability.
Week 9 : 4 November - 10 November	Lecture	Applications, including discussion of the damped pendulum. Invariant sets and the Poincaré-Bendixson Theorem.
Week 10 : 11 November - 17 November	Lecture	Special topics, presentations and revision.

Attendance Requirements

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

General Schedule Information

There will be two assessments, one due at the end of week 6 and one due at the end of week 9.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
	Jim Pettigrew					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.**