UNSW Course Outline

MATH6781 Biomathematics - 2024

Published on the 25 May 2024

General Course Information

Course Code : MATH6781
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 : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course introduces mathematical modelling and data analysis for biological and biomedical systems. The course is suitable for students with an interest in the real-world application of differential equation modelling. Examples of the biological systems studied in the course include: population dynamics, the spread of infectious diseases, drug delivery and metabolism,

biochemical reactions, the formation of animal coat patterns, and the growth of tumours. The emphasis in this course is on the development of the governing model equations, and on the analysis and interpretation of the model solutions. Methods for computer simulation of the model equations will be demonstrated but students' knowledge of these methods will not be assessed in the course.

In addition to lectures, the course will feature tutorials and workshops. Weekly tutorials require the class to solve a series of mathematical problems that build upon the lecture material. Workshops (several during the course) further consolidate the lecture material as the class makes use of modelling, analysis and computer simulations to perform in-depth studies of particular biological applications.

Assumed Knowledge:

Completion of two years of an undergraduate degree in mathematics or statistics.

Course Aims

The aim of this course is to introduce students to the broad field of Biomathematics, with particular emphasis on differential equation modelling of biological and biomedical systems. The course aims to provide knowledge on the development, solution and analysis of different types of differential equation models. The ability to interpret the solutions and analyses of these models in the context of the relevant biological systems is a key focus of student learning. The skills in modelling, analysis and enquiry developed during this course will be useful for all future endeavours in applied mathematics and science.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Communicate discipline specific information in written form with appropriate referencing.
CLO2 : Mathematically analyse ordinary differential equation models of biological systems by identifying steady states, their stability, and any bifurcations that occur as a parameter is varied.
CLO3 : Derive or explain ordinary differential equation models for the time-dependent dynamics of populations, epidemics, drug metabolism and chemical reactions, and analyse and interpret the solutions of such models.
CLO4 : Derive or explain partial differential equation models for the time-dependent dynamics of structured populations and the spatio-temporal dynamics of biological diffusion and transport, and analyse and interpret the solutions of such models.

Course Learning Outcomes	Assessment Item
CLO1 : Communicate discipline specific information in written form with appropriate referencing.	• Class Test 1 • Assignment • Class Test 2 • Exam
CLO2 : Mathematically analyse ordinary differential equation models of biological systems by identifying steady states, their stability, and any bifurcations that occur as a parameter is varied.	• Class Test 1 • Assignment • Class Test 2 • Exam
CLO3 : Derive or explain ordinary differential equation models for the time-dependent dynamics of populations, epidemics, drug metabolism and chemical reactions, and analyse and interpret the solutions of such models.	• Class Test 1 • Assignment • Class Test 2 • Exam
CLO4 : Derive or explain partial differential equation models for the time-dependent dynamics of structured populations and the spatio-temporal dynamics of biological diffusion and transport, and analyse and interpret the solutions of such models.	• Class Test 2 • Exam

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Learning and Teaching in this course

Moodle

Login to Moodle (http://moodle.telt.unsw.edu.au) to find announcements, general information, lecture slides, tutorial materials, etc. You should check the Moodle site for updates on a regular basis. Please contact the Course Convener if you have not been granted access to the Moodle site.

Marks obtained during the term can be seen in the Moodle gradebook. You should check that the marks recorded are correct and report any discrepancy to the Course Convenor.

ECHO360

The lectures and tutorials are recorded and you can view these recordings in ECHO 360. A link is provided on the Moodle site.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Class Test 1 Assessment Format: Individual	15%	Start Date: Not Applicable Due Date: Week 3
Assignment Assessment Format: Individual	10%	Due Date: Week 7 (Monday 08/07/24, 4pm)
Class Test 2 Assessment Format: Individual	15%	Start Date: Not Applicable Due Date: Week 8
Exam Assessment Format: Individual	60%	Due Date: See myUNSW for exam timetable

Assessment Details

Class Test 1

Assessment Overview

Class Test 1 will assess your knowledge of the topics covered in lectures and tutorials in Weeks 1-2 inclusive. The test will run during lecture time in Week 3 with a time limit of 45 minutes. The test will consist of 2-3 problem solving questions, each with multiple parts. You will be provided with feedback via comments and/or solutions.

Course Learning Outcomes

- CLO1 : Communicate discipline specific information in written form with appropriate referencing.
- CLO2 : Mathematically analyse ordinary differential equation models of biological systems by identifying steady states, their stability, and any bifurcations that occur as a parameter is varied.
- CLO3 : Derive or explain ordinary differential equation models for the time-dependent dynamics of populations, epidemics, drug metabolism and chemical reactions, and analyse and interpret the solutions of such models.

Detailed Assessment Description

Class Test 1 will assess your knowledge of the topics covered in lectures and tutorials in Weeks 1-2 inclusive. The test will run during lecture time in Week 3 with a time limit of 45 minutes. The test will consist of 2-3 problem solving questions, each with multiple parts. You will be provided with feedback via comments and/or solutions.

Assessment Length

45 minutes

Assignment submission Turnitin type

Not Applicable

Assignment

Assessment Overview

The assignment will be worksheet-based and will make an in-depth assessment of your knowledge of some of the topics covered in lectures in Weeks 1-4 inclusive. The assignment will be distributed in Week 4 and will be due in Week 7. The assignment will consist of 1-2 problem solving questions, each with multiple parts. You can expect that the assignment will be more challenging than the problems that you encounter in Class Test 1 and your tutorials. You will be provided with feedback via comments and/or solutions.

Course Learning Outcomes

- CLO1 : Communicate discipline specific information in written form with appropriate referencing.
- CLO2 : Mathematically analyse ordinary differential equation models of biological systems by identifying steady states, their stability, and any bifurcations that occur as a parameter is varied.
- CLO3 : Derive or explain ordinary differential equation models for the time-dependent dynamics of populations, epidemics, drug metabolism and chemical reactions, and analyse and interpret the solutions of such models.

Detailed Assessment Description

The assignment will be worksheet-based and will make an in-depth assessment of your knowledge of some of the topics covered in lectures in Weeks 1-4 inclusive. The assignment will be distributed in Week 4 and will be due in Week 7. The assignment will consist of 1-2 problem solving questions, each with multiple parts. You can expect that the assignment will be more challenging than the problems that you encounter in Class Test 1 and your tutorials. You will be provided with feedback via comments and/or solutions.

Assessment information

Standard late submission penalties will apply.

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Class Test 2

Assessment Overview

Class Test 2 will assess your knowledge of the topics covered in lectures and tutorials in Weeks 3-5 inclusive. The test will run during lecture time in Week 8 with a time limit of 45 minutes. The test will consist of 2-3 problem solving questions, each with multiple parts. You will be provided with feedback via comments and/or solutions.

Course Learning Outcomes

- CLO1 : Communicate discipline specific information in written form with appropriate referencing.
- CLO2 : Mathematically analyse ordinary differential equation models of biological systems by identifying steady states, their stability, and any bifurcations that occur as a parameter is varied.
- CLO3 : Derive or explain ordinary differential equation models for the time-dependent dynamics of populations, epidemics, drug metabolism and chemical reactions, and analyse and interpret the solutions of such models.
- CLO4 : Derive or explain partial differential equation models for the time-dependent dynamics of structured populations and the spatio-temporal dynamics of biological diffusion and transport, and analyse and interpret the solutions of such models.

Detailed Assessment Description

Class Test 2 will assess your knowledge of the topics covered in lectures and tutorials in Weeks 3-5 inclusive. The test will run during lecture time in Week 8 with a time limit of 45 minutes. The test will consist of 2-3 problem solving questions, each with multiple parts. You will be provided with feedback via comments and/or solutions.

Assessment Length

45 minutes

Assignment submission Turnitin type

Not Applicable

Exam

Assessment Overview

The final exam will assess your knowledge of all topics covered during lectures and tutorials throughout the term. The exam will run during the official university examination period with a time limit of 2 hours. The exam will consist of 4 equally weighted problem solving questions, each with multiple parts. Feedback is available via inquiry with the course convenor.

Course Learning Outcomes

- CLO1 : Communicate discipline specific information in written form with appropriate referencing.
- CLO2 : Mathematically analyse ordinary differential equation models of biological systems by identifying steady states, their stability, and any bifurcations that occur as a parameter is varied.
- CLO3 : Derive or explain ordinary differential equation models for the time-dependent dynamics of populations, epidemics, drug metabolism and chemical reactions, and analyse and interpret the solutions of such models.
- CLO4 : Derive or explain partial differential equation models for the time-dependent dynamics of structured populations and the spatio-temporal dynamics of biological diffusion and transport, and analyse and interpret the solutions of such models.

Detailed Assessment Description

The final exam will assess your knowledge of all topics covered during lectures and tutorials throughout the term. The exam will run during the official university examination period with a time limit of 2 hours. The exam will consist of 4 equally weighted problem solving questions, each with multiple parts. Feedback is available via inquiry with the course convenor.

Assessment Length

2 hours

Assignment submission Turnitin type

Not Applicable

General Assessment Information

The marks for Class Test 1 (15%), the Assignment (10%), and Class Test 2 (15%) will be recorded into Moodle once available. Students can then verify their marks and determine their pre-exam mark (worth 40%).

Grading Basis

Standard

Requirements to pass course

To pass this course your will need a composite mark of at least 50 out of 100. The composite mark is calculated using the weightings of the 4 assessment items: Class Test 1 (15%), Assignment (10%), Class Test 2 (15%) and Final Exam (60%).

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Topic	Single Species Population Models
Week 2 : 3 June - 9 June	Topic	Interacting Species Population Models
Week 3 : 10 June - 16 June	Topic	Epidemic Modelling
	Assessment	Class Test 1 (Friday 2:10pm, In Lecture)
Week 4 : 17 June - 23 June	Topic	Bifurcations Nondimensionalisation Delay Equations Compartment Models/Pharmacokinetics
	Assessment	Assignment Released
Week 5 : 24 June - 30 June	Topic	Chemical Reactions Diffusion Equations
Week 6 : 1 July - 7 July	Topic	FLEXIBILITY WEEK
Week 7 : 8 July - 14 July	Topic	Reaction-Diffusion Equations Advection Equations
	Assessment	Assignment Due (Monday 4pm)
Week 8 : 15 July - 21 July	Topic	Age-Structured Models Chemotaxis
	Assessment	Class Test 2 (Friday 2:10pm, In Lecture)
Week 9 : 22 July - 28 July	Topic	Turing Patterns Tumour Growth Models
Week 10 : 29 July - 4 August	Topic	Atherosclerotic Plaque Models (Non-examinable) Revision

Attendance Requirements

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

General Schedule Information

The weekly schedule for MATH6781 is as follows:

- Four hours of lectures (**Wednesday 11:05am-12:55pm** in Tyree Energy Technology LG05 and **Friday 2:05pm-3:55pm** in Electrical Engineering G23). Class Test 1 and Class Test 2 will be held during the first lecture hour on Friday of Week 3 and Week 8, respectively.
- One hour of classroom tutorial (**Thursday 1:05pm-1:55pm** in Old Main Building 230).

Course Resources

Recommended Resources

There is no required textbook for this course. The following textbooks are recommended for students who wish to learn about the course material in greater depth:

- Mathematical Models in Biology, L. Edelstein-Keshet, 1988, Random House.
- Mathematical Biology 1: An Introduction (Third Edition), J. D. Murray, 2002, Springer-Verlag.

- Essential Mathematical Biology, N. F. Britton, 2003, Springer-Verlag.
- Biology in Space and Time: A Partial Differential Equation Modeling Approach, J. P. Keener, 2021, American Mathematical Society.

Course Evaluation and Development

Students are encouraged to provide informal feedback to the Course Convener at any time. Formal feedback will also be collected via the end-of-term myExperience surveys. All feedback will be carefully considered for the purpose of course development.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Michael Watson		H13 Lawrence East 4075		via email	No	Yes
Administrator	Hilda Cahya		H13 Lawrence East 3072		via email	Yes	No
Lecturer	Cathy Gray					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.**