School of Information and Physical Sciences

MATH1800: Mathematical Modelling

Callaghan
Semester 2 - 2023

COURSE OUTLINE

OVERVIEW

Course Description

Mathematical modelling is key to bridging the gap between mathematics and solving real-world problems. Whether used to simulate the spread of an infectious disease or predict the trajectory of a falling satellite, mathematical modelling permeates disciplines across academia and industry. This course provides an overview of essential mathematical modelling techniques and their application to real-world problems, providing an introduction to the entire modelling process: model construction, analysis and research. Surveying general techniques, the course will also focus on a number of illustrative case studies covering topics across the spheres of the natural world and human endeavour, from environmental issues, to biology, ecology, medicine, nanotechnology, forensic sciences, engineering, business and commerce.

Assumed Knowledge

The course has assumed knowledge of Advanced Mathematics in the HSC Band 5 or higher. Students with a result of Band 4 or less in 2unit Mathematics in the HSC should complete MATH1002 and MATH1110 before attempting MATH1800.

Contact Hours

Callaghan
Computer Lab
Face to Face On Campus
2 hour(s) per Week for 11 Weeks
Workshops are incorporated in the computer lab.
Compulsory Requirement: Every student must attend a minimum of 80% of Computer Labs to meet course requirements
Lecture
Face to Face On Campus
2 hour(s) per Week for Full Term

Unit Weighting
Workload

10
Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

CONTACTS

Course Coordinator

Callaghan
Prof Mike Meylan
Mike.Meylan@newcastle.edu.au
(02) 4921 6792
Consultation:

Teaching Staff

Other teaching staff will be advised on the course Canvas site.

School Office

School of Information and Physical Sciences
SR233, Social Sciences Building
Callaghan
CESE-SIPS-Admin@newcastle.edu.au
+61 2 4921 5513
9am-5pm (Mon-Fri)

SYLLABUS

Course Content

1. Standard model techniques to solve particular real life problems: models based on difference and/or differential equations and their systems; models based on proportionality, geometric similarity.
2. Analysis of the relationships between model formulation and solution and its stability.

Course Learning Outcomes

On successful completion of this course, students will be able to:

1. Outline how mathematics can improve our understanding of the natural world and the world of human endeavour.

2. Apply mathematical strategies and techniques to solve real-world problems.

3. Demonstrate improved quantitative and analytical skills in solving real life problem by combining multiple pieces of evidence to effectively construct, solve and analyse basic mathematical model as compared with those skills at the prerequisite level.

4. Use mathematical and scientific terminology to justify reasoning.

5. Develop and use computer software for mathematical modelling.

6. Work in a group to gather, compare and summarise information from a range of sources and disciplines.

Course Materials

Lecture Materials:

- Available on the canvas site

Recommended Reading:

- A case studies approach/Ed. Reinhard Illner et al., American Mathematical Society, 2005

- Essential mathematics and statistics for forensic science, Craig Adam, Wiley-Blackwell, 2010.;

- An introduction to difference equations, Saber Elaydi, Springer, 2005;

- Modelling and mechanics of carbon-based nanostructured materials, Duangkamon Baowan, Barry J. Cox, Tamsyn A. Hilder, James M. Hill & Ngamta Thamwattana, Micro & Nano Technologies Series, Elsevier, 2017

SCHEDULE

Week	Week Begins	Topic	Learning Activity	Assessment Due
1	17 Jul	Lecture 1: Introduction to mathematical modelling with difference equations	NO WORKSHOP	
2	24 Jul	Lecture 2: Solutions of difference equations	Laboratory workshop 1 on L1	
3	31 Jul	Lecture 3: Systems of difference equations	Laboratory workshop 2 on L12	Assignment 1
4	7 Aug	Lecture 4: Differential equations	Laboratory workshop 3 on L3	Assignment 2
5	14 Aug	Lecture 5: Modelling examples	Laboratory workshop 5 on L5	Assignment 3
6	21 Aug	Lecture 6: Review	Laboratory workshop 5 on L5	Assignment 4
7	28 Aug	Lecture 7: Mathematics in forensic sciences 1	Revision: Q&A	Assignment 5
8	4 Sep	Mid-semester test	Laboratory workshop 6 on Group Work (part 1)	Mid-semester test (in lecture)
9	11 Sep	Lecture 8: Mathematics in forensic sciences 2	Laboratory workshop 6 on Group Work (part 2)	
10	18 Sep	Lecture 9: Mathematics in nanotechnology 1	Laboratory workshop 7 on L7 & L8	Group report project
Mid Term Break				
Mid Term Break				
11	9 Oct	Lecture 9: Mathematics in nanotechnology 2	Laboratory workshop 8 on L9	Assignment 6
12	16 Oct	Lecture 11: Review	Revision: Q&A	Assignment 7
13	23 Oct			
Examination Period				
Examination Period				

ASSESSMENTS

This course has 4 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Group Project	9 am Thursday of week 10. Please see timetable for more details.	Group	10%	1, 2, 3, 4, 5, 6
2	Examination	Exam period	Individual	50%	1, 2, 3, 4, 5
3	Mid Term Test	Week 8	Individual	25%	1, 2, 3, 4, 5
4	Assignments	9 am Thursday of weeks 3-7, 11, 12. Please see timetable for more details.	Individual	15%	1, 2, 3, 4, 5

Late Submissions The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for

that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

Assessment 1 - Group Project

Assessment Type Project
Description Group project
Weighting 10%
Due Date 9 am Thursday of week 10. Please see timetable for more details.
Submission Method Online
Assessment Criteria Mathematical correctness and clarity of presentation
Return Method Online
Feedback Provided Online - .

Assessment 2 - Examination

Assessment Type Formal Examination
Purpose To test individual student knowledge of the course material as well as analytical and problem solving ability.
Description Formal exam. A handwritten or typed A4 double sided page of notes (memory aid) is permitted.
Weighting 50%
Due Date Exam period
Submission Method Formal Exam
Assessment Criteria Mathematical correctness and clarity of presentation
Return Method Not Returned
Feedback Provided

Assessment 3 - Mid Term Test

Assessment Type In Term Test
Purpose To test individual student knowledge of the course material as well as analytical and problem solving ability.
Description Conducted in the lecture time and location slot in Week 8.
A handwritten or typed A4 double sided page of notes (memory aid) is permitted.
Weighting 25%
Due Date Week 8
Submission Method In Class
Assessment Criteria Mathematical correctness and clarity of presentation
Return Method In Person
Feedback Provided In Person - .

Assessment 4 - Assignments

Assessment Type Written Assignment
Description
Weighting 15%
Due Date 9 am Thursday of weeks 3-7, 11, 12. Please see timetable for more details.
Submission Method Online
Assessment Criteria Mathematical correctness and clarity of presentation
Return Method Online
Feedback Provided Online - .

ADDITIONAL INFORMATION

Grading Scheme

This course is graded as follows:

Range of Marks	Grade	Description
85-100	High Distinction (HD)	Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of

		skills*; and achievement of all assessment objectives.
75-84	Distinction (D)	Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives.
65-74	Credit (C)	Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes.
50-64	Pass (P)	Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes.
0-49	Fail (FF)	Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following disciplinary action.

*Skills are those identified for the purposes of assessment task(s).

Communication Methods

Communication methods used in this course include:

- Canvas Course Site: Students will receive communications via the posting of content or announcements on the Canvas course site.
- Email: Students will receive communications via their student email account.

Attendance

Attendance/participation will be recorded in the following components:

- Workshop (Method of recording: UON Attendance check-in App and manual check-in by demonstrator)

Oral Interviews (Vivas)

As part of the evaluation process of any assessment item in this course an oral examination (viva) may be conducted. The purpose of the oral examination is to verify the authorship of the material submitted in response to the assessment task. The oral examination will be conducted in accordance with the principles set out in the Oral Examination (viva) Procedure. In cases where the oral examination reveals the assessment item may not be the student's own work the case will be dealt with under the Student Conduct Rule.

Academic Misconduct

All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to https://policies.newcastle.edu.au/document/view-current.php?id=35.

Adverse Circumstances

The University acknowledges the right of students to seek consideration for the impact of allowable adverse circumstances that may affect their performance in assessment item(s). Applications for special consideration due to adverse circumstances will be made using the online Adverse Circumstances system where:

1. the assessment item is a major assessment item; or
2. the assessment item is a minor assessment item and the Course Co-ordinator has specified in the Course Outline that students may apply the online Adverse Circumstances system;
3. you are requesting a change of placement; or
4. the course has a compulsory attendance requirement.

Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at:
https://policies.newcastle.edu.au/document/view-current.php?id=236

Important Policy

The Help button in the Canvas Navigation menu contains helpful information for using the

Information	Learning Management System. Students should familiarise themselves with the policies and procedures at https://www.newcastle.edu.au/current-students/no-room-for/policies-and-procedures that support a safe and respectful environment at the University.

This course outline was approved by the Head of School. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.