

School of Mathematics and Statistics

MAST90026 Computational Differential Equations

2026

Course Outline

In Computational Differential Equations you will learn how to write and implement numerical solutions to a variety of problems commonly encountered in science and engineering. Understanding the behaviour of the mathematical problem gives insight into the pitfalls for the unwary in using canned packages inappropriately or uncritically.

- The subject will cover different material to MAST30028. However, students with previous experience in MATLAB and numerical techniques will be better prepared than those without.
- This year the course will cover numerical methods for two-point boundary value problems and for common partial differential equations in 1 and 2 spacial dimensions.
- Topics will include: boundary value problems for ordinary differential equations; the solution of parabolic, hyperbolic and elliptic partial differential equations, finite difference, finite element and spectral methods.

Prerequisites

There are no formal prerequisites for this unit, however, **the assessment for this class is in MATLAB**, so some previous experience will be beneficial. Additionally, it is recommended that students have **completed a subject in partial differential equations**.

Classes

Monday 5PM – 6PM and Friday 11AM – 1PM Room 5013, Building 110 (The Spot). **There are no desktop computers in this room. Students will need to bring a laptop/tablet with MATLAB installed or access to MATLAB online. Ensure you have a working MATLAB environment before the first class.**

Public Holidays

There will be no classes on the following dates:

- 09/03/2026 (Labor Day) and
- 03/04/2026 (Good Friday).

Consultation Hours

My consultation hours are Friday 1:30 – 4:30PM in Room 201 in Old Geology South.

Assessments

- Four (4) weekly homework problems, worth 20% in total (released on Friday 2PM in Weeks 1–4 and due on Friday 11:59PM in Weeks 2–5, respectively).
 - Homework 4 will be released a day earlier on Thursday the 26th of March and due on the Thursday the 2nd of April. This is due to the Good Friday public holiday.
- Three (3) assignments, worth 20% each (released on Friday 2PM in Weeks 5, 7, 9) due on Friday 11:59PM in Weeks 7, 9, 11, respectively.
- One (1) 15 minute group talk including a copy of slides provided to me, worth 20%. Held in week 12 (possibly also week 11 depending on size of class).

Note: Due to the late submission time, I will be uncontactable from close of business on Friday until the following Monday morning. Any late submissions will not be marked and awarded a grade of 0. If there are extenuating circumstances apply for an extension or special consideration (more information available in the assessment adjustments page in the student support module).

Approximate Content Schedule

Starting	Content	Software	Refs.
2 Mar	BVPs I: Finite Differences (FD)		L, I
9 Mar	BVPs II: Collocation methods		S
15 Mar	BVPs III: Finite elements (FEM)		I
22 Mar	Handling nonlinearity		
29 Mar	Elliptic eq. I: FD		I
	Mid semester break (1 week)		
12 Apr	Elliptic eq. II: FEM		G
19 Apr	Iterative methods for linear systems		G, L
26 Apr	Parabolic equations I: Method of Lines (MOL)		L
3 May	Parabolic equations II: FD		L
10 May	Hyperbolic equations: FD		L
17 May	Evolution equations : operator splitting		L
24 May	Student talks		

It is likely we will deviate from the schedule slightly due to public holidays however, the topics will be covered in this order.

References

These books go beyond the subject in coverage, and somewhat in depth however they offer a good background.

- G Gockenbach, *Understanding and implementing the finite element method*, SIAM, 2006.
- I Iserles, *A first course in the numerical analysis of differential equations*, 2nd ed., CUP, 2008.
- L Leveque, *Finite Difference Methods for Ordinary and Partial Differential Equations: Steady-State and Time-dependent problems*, SIAM, 2007. Note: Available online through University Libraries.
- S Jie Shen, Tao Tang, and Li-lian Wang, *Spectral methods. Algorithms, analysis and applications*, Springer Series in Computational Mathematics, 41. Springer, Heidelberg, 2011. Note: Available online through University Libraries.

Patrick Grant
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