MATH0058 Computational Methods

Year:	2024–2025
Code:	MATH0058
Level:	5 (UG)
Normal student group(s):	Year 2 and 3 Mathematics degrees
Value:	15 credits (= 7.5 ECTS credits)
Term:	2
Assessment:	60% examination, 40% coursework
Normal Pre-requisites:	MATH0006, MATH0010. Some programming knowledge is desirable, as covered in MATH0011.
Lecturer:	Dr M Jensen

Course Description and Objectives

Throughout the last fifty years fast numerical methods have revolutionised the applications of mathematics, making it possible to simulate huge problems in science and engineering that are intractable by analytic methods. This course is designed to give an overview of the design, analysis and implementation of the most fundamental numerical techniques in numerical linear algebra, the interpolation of functions, and the evaluation of integrals. The course will be heavily based on Python as the programming language and will use Python for many examples throughout.

Students are strongly advised to have some previous programming experience in any language, such as the Python material covered in the MATH0011.

Recommended Texts

(a) B. A. Cipra *"The Best of the 20th Century: Editors Name Top 10 Algorithms"*, http://www.siam.org/pdf/news/637.pdf. A two page overview of the most influential algorithms of the 20th century.

(b) E. Suli and D. Mayers *"An Introduction to Numerical Analysis"*, Cambridge University Press. An excellent introduction into the topic. Many of the theoretical aspects of the course will be based on this book.

(c) G. Strang *"Computational Science and Engineering"* A beautiful book explaining many of the fundamental algorithms in Applied Mathematics.

(d) N. J. Higham *"Accuracy and Stability of Numerical Algorithms"* The standard text about finite precision arithmetic on computers and the effects on the stability of modern algorithms. Parts of the course about stability analysis are based on this book.

Detailed Syllabus

- Efficient solution of linear systems of equations by LU decomposition.
- An introduction to stability analysis, forward/backward errors and condition numbers.
- Least-Squares problems and the SVD.

– Eigenvalue computations.

– Interpolation of functions.

– Numerical Integration of functions.