Liverpool John Moores University

Title:	NUMERICAL METHODS
Status:	Definitive
Code:	**5003MATHS** (119188)
Version Start Date:	01-08-2018
Owning School/Faculty:	Applied Mathematics
Teaching School/Faculty:	Applied Mathematics

Team	Leader
Ian Jarman	Y
Paul Strickland	

Academic Level:	FHEQ5	**Credit Value:**	24	**Total Delivered Hours:**	66
Total Learning Hours:	240	**Private Study:**	174		

Delivery Options
Course typically offered: Standard Year Long

Component	Contact Hours
Lecture	14
Practical	52

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Report	AS1	Task containing a number of exercises to be solved using a combination of pen-paper techniques and software application.	25	
Test	AS2	In class assessment where questions to be solved using a combination of handwritten and software applications.	25	
Report	AS3	Applications of Chaos and Fractals.	50	

Aims

Acquaint the student with practical methods for solving applied problems.
Develop an understanding of the analysis of the methods used.
Develop the need to analyse and interpret numerical solutions to problems.
Enable students to study and investigate the error of certain numerical methods.
Provide practical experience in the use of numerical methods and appropriate software.
An ability to analyse a range of real-world applications of number systems beyond the real line.
Identification of areas where complex dynamics apply, and associated computation.
Development of 3- and higher dimensional intuition through appropriate tools.

Learning Outcomes

After completing the module the student should be able to:

1	Understand the importance of numerical methods for applied problems with no analytical solutions.
2	Develop appropriate analysis of the numerical methods.
3	Identify stable and robust numerical methods and their software implementation.
4	Analyse and interpret numerical solutions to problems.
5	Identify and analyse abstract and real systems which exhibit chaotic behavior.
6	Construct fractals from simple patterns and replication rules.
7	Calculate the generalised dimension of a set.

Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

Report 1	1	2	
Test	3	4	
Report 2	5	6	7

Outline Syllabus

Decimal search, bisection and linear interpolation.
Fixed point iteration, secant and Newton Raphson methods. Analysis of the methods.
Taylor series and its error term.
Error analysis of the above methods.
Numerical integration: mid-point, trapezium, Simpson's rules. Error analysis/order of convergence and applications to Richardson's extrapolation and Romberg integration.
Solution of Ordinary Differential Equations: First and second order, Euler, modified Euler, Runge-Kutta order 4, Taylor methods.
One-dimensional dynamical systems.
The Mandelbrot set and its associated Julia sets.

Fractals via replication rules.
Examples of approximate fractals in nature.
Fractals with a random element.
Applications in computer graphics.
Towards a definition of chaos.

Learning Activities

Students will use appropriate mathematical software to develop their understanding of the subject area.

Notes

The fractals and chaos element of the module will enable the students to apply advanced mathematical techniques to 3D graphics and the analysis of dynamical systems.