Module Proforma

Approved, 2022.03

Summary Information

Module Code	5103MATHS
Formal Module Title	Numerical Methods
Owning School	Computer Science and Mathematics
Career	Undergraduate
Credits	20
Academic level	FHEQ Level 5
Grading Schema	40

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
Ian Jarman	Yes	N/A

Module Team Member

Contact Name	Applies to all offerings	Offerings
James Baker	Yes	N/A

Partner Module Team

Contact Name	Applies to all offerings	Offerings

Teaching Responsibility

LJMU Schools involved in Delivery
Computer Science and Mathematics

Learning Methods

Learning Method Type	Hours
Lecture	22
Practical	33

Module Offering(s)

Offering Code	Location	Start Month	Duration
JAN-CTY	CTY	January	12 Weeks

Aims and Outcomes

Aims	To motivate the need to solve problems numerically, and interpret numerical solutions to problems. To enable students to study and investigate the error of certain numerical methods. Provide practical experience in the use of numerical methods and appropriate software. To give students the confidence to solve equations and problems arising in dynamical systems and fractal analysis independently.

Learning Outcomes

After completing the module the student should be able to:

Code	Description
MLO1	Select appropriate methods to obtain numerical solutions to a range of problems.
MLO2	Classify which numerical methods are both stable and robust, and be able to implement them using mathematical software.
MLO3	Analyse and interpret numerical solutions to problems.
MLO4	Identify both abstract and real systems which exhibit chaotic behaviour, and investigate their solution.
MLO5	Create fractals using simple patterns and replication rules.

Module Content

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. Computations of fixed and periodic points in real and complex dynamic systems. Logistic and Mandelbrot maps. Construction of iterated function systems using contractive affine maps.

Module Overview
The aim of this module is to develop an understanding of the need to analyse and interpret numerical solutions to problems. You will study and investigate the error of certain numerical methods and be provided with practical experience in the use of numerical methods and appropriate software.

Additional Information
Acquaint the student with practical methods for solving applied problems, and develop an understanding of the analysis of the methods used. The fractals and chaos element of the module will enable students to apply advanced mathematical techniques to 3D graphics and the analysis of dynamical systems.

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Learning Outcome Mapping
Portfolio	Portfolio	75	0	MLO2, MLO3, MLO1
Centralised Exam	Exam	25	1	MLO5, MLO1, MLO4