Liverpool John Moores University

Title:	Numerical Methods in Astrophysics
Status:	Definitive
Code:	**7015ASTPHY** (124778)
Version Start Date:	01-08-2021
Owning School/Faculty:	Astrophysics Research Institute
Teaching School/Faculty:	Astrophysics Research Institute

Team	Leader
Shiho Kobayashi	Y
Maurizio Salaris	

Academic Level:	FHEQ7	**Credit Value:**	30	**Total Delivered Hours:**	24
Total Learning Hours:	300	**Private Study:**	276		

Delivery Options
Course typically offered: Semester 2

Component	Contact Hours
Online	24

Grading Basis: 50 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Report	Project 1	3000 word Project Report	50	
Report	Project 2	3000 word Project Report	50	

Aims

-This mathematics module aims to provide students with a good understanding of numerical methods though typical astrophysical problems.
- The growth in computing power has revolutionised the use of mathematical models in research, numerical methods have been heavily used in sciences. engineering, and other research fields. Students will lean how to mathematically formulate astrophysical problems, and study how to apply standard numerical methods to obtaining numerical solutions/approximations to the problems.

- Students will have practical experience in the use of numerical methods which are extensively employed by astronomers and astrophysicists.

Learning Outcomes

After completing the module the student should be able to:

1	Apply the techniques of a programming language used by astronomers in a relevant research context
2	Describe and critically analyse numerical modeling in astronomy and astrophysics
3	Understand the standard numerical methods used by scientists in analysis of theoretical problems and experimental data.

Learning Outcomes of Assessments

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

Project Report 1	1	2	3
Project Report 2	1	2	3

Outline Syllabus

A series of lectures will be given to describe astrophysical problems and numerical methods that can be used to address them.
At the end of each series of lectures, students will be given a mini-project.
Project codes will be provided, and students will use the codes to carry out the projects.

The elements covered will be drawn from a variety of observational and theoretical topics and will focus on numerical modelling and analysis. Topics include: Monte Carlo Techniques, Lutz-Kelker and Malmquist biases on a sample of stars with parallax determinations, Numerical methods to solve ordinary differential equations: Euler and Runge-Kutta methods, Stellar motions in gravitational potentials, Partial differential equations and finite difference methods.

Learning Activities

Distance learning with tutorial support
Learning materials delivered by Virtual Learning Environment to include directed reading, online lectures, online assessments with feedback, online discussions

Notes

There will be particular emphasis on developing independent learning skills and IT capability to analyse mathematical/astrophysical complex systems based on the standard numerical methods. Students will be able to access a dedicated teaching

server at LJMU to carry out numerical projects. Mathematics is heavily used in this module and students are expected to have solid understanding of basic maths and physics (undergraduate year one and two level).

Since detailed instructions on how to modify the codes will be given, programming skills or knowledge in specific numerical languages is not prerequisite. However, students should be able to analyse data sets produced by the project codes by using their choice of software (simple operations such as evaluating the average, finding maximum, plotting specific components of the data in a 2 dimensional space etc) or at least they should be willing to learn a data analysis tool with the guidance from lecturers.

Module will be delivered by distance learning.