Module Proforma

Approved, 2022.03

Summary Information

Module Code	7015ASTPHY
Formal Module Title	Numerical Methods in Astrophysics
Owning School	Astrophysics Research Institute
Career	Postgraduate Taught
Credits	30
Academic level	FHEQ Level 7
Grading Schema	50

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
Shiho Kobayashi	Yes	N/A

Module Team Member

Contact Name	Applies to all offerings	Offerings
Maurizio Salaris	Yes	N/A
Stacey Habergham-Mawson	Yes	N/A
Matthew Darnley	Yes	N/A

Partner Module Team

Contact Name	Applies to all offerings	Offerings

Teaching Responsibility

LJMU Schools involved in Delivery
Astrophysics Research Institute

Learning Methods

Learning Method Type	Hours
Online	24

Module Offering(s)

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

Aims and Outcomes

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:

Code	Description
MLO1	Apply the techniques of a programming language used by astronomers in a relevant research context
MLO2	Describe and critically analyse numerical modelling in astronomy and astrophysics
MLO3	Understand the standard numerical methods used by scientists in analysis of theoretical problems and experimental data.

Module Content

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.

Module Overview

This module aims to give students an understanding of programming basics and provide students with practical experience of using computational techniques extensively employed by researchers in astronomy and astrophysics.

There will be particular emphasis on developing independent learning skills and IT capability to access and extract relevant scientific information via the Virtual Learning Environment and databases available from LJMU.

Additional Information

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.

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Learning Outcome Mapping
Report	Project Report 1	50	0	MLO3, MLO2, MLO1
Report	Project Report 2	50	0	MLO3, MLO2, MLO1