

Course Title: Astrophysical Fluid Dynamics

Course Lecturer: Dr Anne Marie Nzioki

Course credits: 1

Lecturer contact hours: 24

Tutorial/practical hours: 10

1) Course overview:

The course aims to introduce students to mathematical methods and concepts of fluid dynamics and their astrophysical applications.

Course Content:

- Fundamental equations of fluids
- Viscous flows:
- Sound waves
- Shocks
- Spherical Accretion
- Viscous accretion
- Fluid instabilities

2) Course breakdown/syllabus:

- *Fundamental equations of fluids:*

The fundamental equations of fluid dynamics, namely, the conservation of mass, momentum, and energy, are derived.

- *Viscous flows:*

The Navier-Stokes equation is derived to account for viscous processes in fluid dynamics and the example of a solution discussed.

- *Sound waves:*

An introduction to sound waves as the oscillatory motion of disturbances in fluids.

- *Shocks:*

This topic deals with the basic theory of shock phenomena, which are discontinuities expected to occur in specific kinds of flow.

- *Spherical Accretion:*

An introduction to accretion phenomena, and in particular spherical accretion of a steady flow (Bondi accretion), by applying the Bernoulli equation.

- *Viscous accretion:*

Derivation of equations of motion for circular viscous flow, also known as accretion disks.

- *Fluid instabilities:*

A variety of fluid instabilities, specifically, Rayleigh-Taylor, Kelvin-Helmholtz and Jeans, are examined.

3) Resources:

- Cathie Clarke and Bob Carswell: 'Principles of Astrophysical Fluid Dynamics', Cambridge University Press 2007; ISBN-13 978-0-511-27379-7.
- Michael J. Thompson: 'An Introduction to Astrophysical Fluid Dynamics', Imperial College Press, London 2006; ISBN 1-86094-615-1.
- Landau & Lifshitz: Fluid Mechanics, 'Course of Theoretical Physics 'Volume 6, Pergamon Press, Oxford 1959; ISBN 0750627670.
- Steven N. Shore: 'Astrophysical Hydrodynamics ', Wiley-VCH 2007; ISBN 978-3-527-40669-2.

Lecture notes will be uploaded on VULA.

4) Breakdown of practicals/tutorials:

There will be a set of tutorial problems covering each topic, which the students are expected to attempt on their own. Assistance will be provided for the tutorial questions.

5) Additional skills to be developed during the course:

The students will be required to write a research essay assignment. This will help the students develop the written and research skills needed for academic purposes.

6) Assessment

20%: Two quizzes (10% each)

50%: Two 'Take-home' exams (25% each)

30%: One Essay