

Course Title: Astrophysical Fluid Dynamics

Course Lecturer: Dr Anne Marie Nzioki

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Lecture hours: 20

Tutorial 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:

These are the recommended books for the course:

- Landau & Lifshitz: Fluid Mechanics, 'Course of Theoretical Physics', Volume 6, Pergamon Press, Oxford 1959.
- Cathie Clarke and Bob Carswell: 'Principles of Astrophysical Fluid Dynamics', Cambridge University Press 2007.
- Steven N. Shore: 'Astrophysical Hydrodynamics: An Introduction', Wiley-VCH; 2nd edition, 2007.
- Michael J. Thompson: 'An Introduction to Astrophysical Fluid Dynamics', Imperial College Press, London 2006.
- Juhan Frank, Andrew King, Derek Raine: 'Accretion Power in Astrophysics', Cambridge Cambridge University Press cop. 2002.

Lecture notes will be uploaded on Amathuba.

4) Lectures:

On the days allocated to the AFD course in the timetable, lectures will be held on Zoom. The Zoom link will be available on the course page on Amathuba.

5) Tutorials:

There will be a set of tutorial problems covering each topic, which the students are expected to attempt and submit and this will constitute a participation mark.

Assistance will be provided for the tutorial questions.

Course tutor: Ansofi Pretorius

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6) Assessment

Participation: 5%

Tests: 40% (4 tests)

Exam: 55%