Hydrodynamics and astrophysical magnetohydrodynamics - astro8403

Course	**Hydrodynamics and astrophysical magnetohydrodynamics**
Course No.	astro8403

Category	**Type**	**Language**	**Teaching hours**	**CP**	**Semester**
Elective	Lecture with exercises	English	2+1	4	ST

Requirements for Participation:

Preparation: Revision of elementary thermodynamics, vector calculus and electromagnetism. Please note that although this course is designed mainly with astrophysics in mind, no knowledge of astrophysics is assumed. Students of other branches of physics are welcome.

Form of Testing and Examination: Exercises throughout the semester, and an oral examination at the end of the course.

Length of Course: 1 semester

Aims of the Course: Almost the entire universe is fluid and so an understanding of many phenomena is impossible without a proper grasp of fluid dynamics. This course introduces the field, drawing on examples from astrophysics as well as atmospheric physics to illustrate the principles. The aim is for the students to develop an intuitive understanding of underlying principles. Roughly the last quarter of the course is an introduction to magnetohydrodynamics; here the emphasis is on astrophysical applications (rather than laboratory/plasma physics).

Contents of the Course: The fluid approximation, Euler equations, ideal fluids, viscous fluids, diffusion of heat, sound waves, hydrostatics, flow around a solid body, the Bernoulli equation, the Reynolds number and other dimensionless parameters used to describe a flow, compressible and incompressible flow, supersonic and subsonic flow, shocks (with example: supernovae), surface & internal gravity waves, vortices and vorticity, waves in a rotating body of fluid (example: earth's atmosphere), stability analysis (examples: convection, shear instability), the magnetohydrodynamics equations, Alfven waves, flux conservation, flux freezing, magnetic pressure and tension, force-free fields, reconnection (with example: solar corona), angular momentum transport and the magneto-rotational instability (example: astrophysical discs).

Recommended Literature:

E.Landau & E.Lifshitz, "Fluid mechanics" Pergamon Press 1987

S.Shore, "Astrophysical hydrodynamics: an introduction", Wiley-VCH 2007

A. Choudhuri, "The physics of fluids and plasmas", Cambridge 1998

Lecture notes at http://www.astro.uni-bonn.de/~jonathan/misc/Hydro_astroMHD.pdf

PDF version of this page.