FED3230 Magnetohydrodynamics 8.0 credits

Magnetohydrodynamik

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FED3230 valid from Spring 2012

Grading scale

Education cycle

Third cycle

Specific prerequisites

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

When completing the course, the student should be able to

- Provide the details of the derivation of ideal and resistive MHD equations

- Describe and explain the domains of validity of one-fluid MHD
- Demonstrate the basic properties of ideal MHD
- Give detailed examples of MHD equilibria and their properties
- Discuss MHD waves
- Derive the Energy principle
- Apply the Energy principle to the Rayleigh-Taylor instability

Course contents

Characteristics of a fluid. Derivation of the fluid equations from Boltzmann's equation. The equations of continuity, momentum and energy transport. Ideal and resistive MHD. Ohm's law. The Lundquist number. Simplifications and domains of validity. Conservation laws. Fluid drifts. Magnetic pressure. Boundary conditions. The virial theorem. Shear and magnetic well. Equilibrium in cylinder geometry. Flux and surface quantities. Pinches. The reversed-field pinch. Toroidicity, the Grad-Shafranov equation. Resistive diffusion. MHD waves and spectra. Stabilising and destabilising forces. Nondimensionalisation of equations. Linearisation. Normal modes. Eigenvalue problems in MHD. The energy principle. Rayleigh-Taylor instability. Resistive instabilities. The magnetosphere. MHD processes in the Sun.

Disposition

Discussion meetings.

Course literature

Parts of the following, or similar, literature:

D. Schnack, University of Wisconsin,Lecture notes,

J. P. Freidberg,Ideal Magnetohydrodynamics, Plenum Press, New York (1987).

J. P. Freidberg,Plasma Physics and Fusion Energy, Cambridge University Press 2007.

Additional notes.

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

Final oral exam.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.