

**MA42007: Mathematics of Fluids and Plasmas 2:
MHD and the Sun. Guide 2011 - 2012**

This module is an introduction to Magnetohydrodynamics and its application to the Sun. In order to take this course you should have completed the modules MA31002 (Differential Equations), MA32002 (Mathematical Methods) and MA41006 (Mathematics of Fluids and Plasmas 1).

Organisation

The module runs for 11 weeks. The module leader, who is responsible for the entire organisation and teaching of the module, is:

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Timetable

There will be three classes each week, usually in the form of two lectures and one tutorial. Class tests will also be held during these hours. Usually the first two will be lectures, the third being used for a tutorial.

A weekly sheet of problems will be made available to students to attempt before each tutorial class. The tutorial hour will be used by the lecturer to answer any questions that students may have.

Assessment

There will be two class tests during the semester which together count for 20% of the assessment. The remaining 80% will come from the two hour Degree Examination in April/May. There is no opportunity to resit this module.

Your Commitment

You are expected to attend all lectures and workshops except on medical grounds or with the special permission of the lecturer. If you are absent from a Class Test on account of medical problems, you should submit a medical certificate to the School Office.

Study Support

If you are having difficulty with the course work you are encouraged to seek help at an early stage at the tutorials. You may also obtain help from the lecturer or Personal Tutor.

Syllabus

1. Electromagnetism:
 - Maxwell's equations,
 - Electrostatics,
 - Magnetostatic fields, magnetic effect of currents,
 - Electrodynamics, Waves.
2. Introduction to properties of plasmas, especially on the Sun.
3. Equations of Magnetohydrodynamics (MHD):
 - Lorentz force, MHD equations, importance of terms,
 - Diffusion and frozen-in flux,
 - Magnetic field lines and flux tubes.
4. MHD solutions:
 - Hydrostatic pressure balance, plasma beta,
 - Potential fields,
 - Force-free fields, coronal arcades,
 - Grad-Shafranov equation.
5. Waves:
 - Linearised MHD equations,
 - Sound waves, Alfvén waves, magnetoacoustic waves.
6. Solar applications:
 - Magnetic reconnection,
 - Magnetic helicity,
 - Dynamo theory,
 - Solar flares, CMEs.

Feedback

At the end of each section of the module you will be asked to complete a confidential questionnaire regarding the content and presentation of the module. This is an important element in the University's Academic Standards procedures.

You may bring matters of concern about the course to the attention of the Mathematics Division Staff/Student Committee, which meets once each semester. A volunteer from level 4 will act as class representative to sit on the Staff-Student Committee; their name will be posted on BlackBoard.

Recommended Books

The main text for the module is: J. P. Hans Goedbloed : Principles of Magnetohydrodynamics, Cambridge University Press, ISBN-13: 978-0521626071 or ISBN-10: 0521626072

Last Modified: 18-August-2011