IM2663 Magnetism and Magnetoelectronics 7.5 credits

Magnetism och magnetoelektronik

Course syllabus for IM2663 valid from Autumn 08

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

Grading scale: A, B, C, D, E, FX, F
Education cycle: Second cycle
Main field of study: Engineering Physics

Intended learning outcomes

*After this course the student will be able to: * describe the microscopic origin and typical magnetic properties of the most common types of magnetic ordering in materials, such as a) ferromagnetism, b) ferrimagnetism, c) antiferromagnetism, and d) superparamagnetism, as well as non-ordered magnetic behavior such as e) paramagnetism and f) diamagnetism. * describe various magnetic characterization techniques. * explain magnetic properties such as a) magnetic moment, b) magnetization, c) hysteresis, d) coercivity, e) remanence, f) permeability, and g) susceptibility, as well as explain how these properties can be determined from magnetic hysteresis loops and other magnetic measurements. * explain the concept of a) magnetic anisotropy, b) the anisotropy field, c) easy and hard axes, and describe the microscopic origin of various types of magnetic anisotropy, such as magnetocrystalline anisotropy and shape anisotropy * explain thermally activated processes leading to phenomena such as superparamagnetism in magnetic nanoparticles, loss of high frequency audio in old cassette tapes and memory loss in hard drives and MRAM. * describe exchange bias and oscillatory antiferromagnetic coupling through non-magnetic spacer materials. * describe charge transport in magnetic and nonmagnetic materials and explain the microscopic origin of various types of magnetoresistance, such as a) Anisotropic Magnetoresistance (AMR), b) Giant Magnetoresistance (GMR), and c) Tunneling Magnetoresistance (TMR) * describe the various parts making up a magnetic hard drive: material layers in the disc, slider, and read & write head. * draw the typical architecture of an MRAM memory cell: Magnetic Tunnel Junction (MTJ), read-select transistor, and write lines. * discuss the various types of memories used in computers, cameras and cell phones, and compare pros and cons of each memory type with the others. * describe spin torque, spin torque switching, and future MRAM archetectures based on this phenomenon * describe spin torque oscillations and the possible future RF components that can be based on this phenomenon*

Course main content

** Magnetic Ordering och Magnetic Materials.* Magnetic Characterization Methods.* Magnetic Properties.* Magnetoresistance and magnetoelectronic devices.* Hard drives and MRAM.* New magnetic phenomena and future applications.*

Language of instruction

Language of instruction is specified in the course offering information in the course and programme directory.

Eligibility

None.

Literature

Introduction to Magnetic Materials, Cullity, B.D. and Graham, C.D.Upplaga: Andra upplagan Förlag: Wiley-IEEE År: 2007

ISBN: 0471477419

Handouts*Modern Magnetic Materials - Principles and Applications, Robert C. O'Handley, Wiley Inter-Science, 2000*
Magnetoelectronics, Ed: Mark Johnson, Elsevier Academic Press, 2004

Handouts

Undervisningsspråk: Engelska

Examination

- ANN1 - Examination, 7.5 credits, grading scale: A, B, C, D, E, FX, F

Requirements for final grade

The course is made up of two parts: 1) Basic magnetism.2) Devices and Applications. After the first part, a written exam will be graded according to the grade scale A/B/C/D/E/Fx/F. During the second half of the course, the student will choose a specific topic and write a short report and give a 10 minute oral presentation to the other students. Both the written report and the oral presentation will be graded accroding to (fail: -1, pass: 0, pass with honours: +1). This grade can both raise or lower the grade from the first part of the course, i.e. it is possible to get a final grade that is both 1 or 2 steps higher or lower than the grade from part 1.