| Module | ***Magnetism*** |
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| Code | 71656 |
| Instruction language | English |
| ECTS credits | 6 |
| Credit hours | 7 |
| Duration | 1 semester |
| Cycle | Each winter semester |
| Coordinator | Dean of Studys Physics |
| Lecturer | Prof. Ulrich Herr, Prof. Berndt Koslowski |
| Allocation to study programmes | Physics M.Sc., elective module, 1st or 2nd semester<br>Wirtschaftsphysik M.Sc., elective module, 1st - 3rd semester |
| Formal prerequisites | None |
| Recommended prerequisites | Fundamentals of electrodynamics, solid state physics (crystallography, electronic structure), statistical physics |
| Learning objectives | Students who completed this course will be able to understand and apply important concepts of magnetism and up-to-date magnetic materials and devices. They will learn to use concepts of solid state and statistical physics to magnetic problems. In hands-on experiments they will acquire expertise in magnetic characterization of materials using modern measurement techniques. |
| Syllabus | Magnetism is a phenomenon which has been applied early after its discovery. The origin are magnetic moments contributed by a magnetic material, or electrical currents. The lecture will introduce types and concepts of magnetism in materials, based on quantitative physical models. Special emphasis will be on applications such as hard and soft magnets, data storage, magnetic resonance imaging, and magnetic sensors. The lecture is accompanied by a set of practical lab experiments focussing on selected aspects of magnetism and its applications.<br><br>**Lecture**<br>• Magnetic phenomena: fundamentals and units<br>• Diamagnetism and paramagnetism<br>• Ferro-, ferri- and antiferromagnetism<br>• Magnetic anisotropy<br>• Magnetic domains and the magnetisation process<br>• Magnetoresistance and Hall effect<br>• Micromagnetism<br>• Magnetic data storage<br>• Magnetic sensor devices<br>• Magnetic resonance imaging<br><br>**Laboratory course**<br>• Vibrating sample magnetometer |

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| | • SQUID magnetometer<br>• MOKE magnetometer and Kerr microscopy<br>• Fluxgate magnetometer<br>• GMR sensors<br>• MRI demonstrator<br>• Micromagnetic simulations |
| Literature | • J.M.D. Coey, Magnetism and Magnetic Materials, Cambridge University Press, 2010<br>• D. Jiles, Introduction to Magnetism and Magnetic Materials, Chapman and Hall/CRC<br>• J. Stöhr, H.C. Siegmann, Magnetism from fundamentals to nanoscale dynamics, Springer, 2006<br>• B.D. Cullity, C.D. Graham, Introduction to magnetic materials, Wiley, 2009<br>• R. Gross, A. Marx, Festkörperphysik, De Gruyter, 2014 |
| Teaching and learning methods | Lecture (3 hours/week)<br>Laboratory course (4 hours/week) |
| Workload | 45 hours lecture (attendance time)<br>60 hours laboratory course (attendance time)<br>75 hours self-study and exam preparation<br>Total: 180 hours |
| Assessment | Written or oral examination. A prerequisite for the participation in the examination is an ungraded course achievement. Form and scope of the examination and of the course achievement are determined and notified by the lecturer at the beginning of the course. |
| Examination | 12364 Magnetism (precourse)<br>12363 Magnetism |
| Grading procedure | The module grade is the examination grade. |
| Basis for | Research in solid state physics |