BuildMoNa

UNIVERSITÄT LEIPZIG

SCIENTIFIC AND METHOD MODULES

Module name	Basic Concepts in Physics
Number	2012-B3
Aims	Doctoral researchers without a physics background will be brought up to a level necessary to understand the thematic and advanced modules (T1–T6, A3, A2). The doctoral researchers will gain insight into the physical principles of materials, the size-dependence of properties, strength- and length dependence of interaction energies, Brownian motion, quantum mechanics and molecular dynamics. They will also be exposed to fundamental concepts of statistical physics and thermodynamics. Moreover, they will gain a feeling for the quantitative analysis that is the basis of physical thinking.
Basics	
Contents	Fundamentals of matter, Solid-state physics (charge transport, band structure, Bloch oscillation, point contacts, tunnelling, magnetotransport), Diffusion (Brownian motion, mass transport, random motion, ballistic motion, dissipation), Hydrodynamics, Nanoconfinement (electrons, photons, phonons, structured dielectric media/photonic crystals, plasmons, metallic nanostructures), Spin physics (magnetic resonance, spin currents), Optics (ray optics, nonlinear optics), Computer simulations (molecular dynamics, Markov chain Monte Carlo methods), Polymer physics (entropic forces, viscoelasticity, polymer dynamics).
Methods	
Type	Two-day block course/ yearly recurrence with modification
Date (month/year)	13/14/21 February 2012
Time	
Work load	15 hours presence/ 45 hours self-study
Examination	Oral/written
Credit points	2
Responsible scientists	Esquinazi, Haase, Janke
International guest lecturers	-
Industrial partners	-
Recommendations for literature, e-learning	"Introduction to solid state physics", by Charles Kittel (several editions) "Solid State Physics", Dan Wei, Cengage Learning "Solid-State Physics", Harald Ibach and Hans Lüth, Springer-Verlag "Solid State Physics", Neil Ashcroft and N. David Mermin, Holt-Saunders International Edition

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SCHEDULE for Module 2012-B3

Time	Lecturer	Programme	Location
13.02.2012			
09:00-13:00	P. Esquinazi	Fundamentals of Solid State Physics, Crystal structures, reciprocal lattice, Classical Theory of an harmonic crystal, Phonons, Thermal properties of solids, Free electron model for metals, Bloch function, the electronic band structure, Fermi surfaces of metals, Charge Transport and the calculation of the electrical resistivity.	Chemistry building SR 102
14.02.2012			
14:00-18:00	W. Janke	Molecular Dynamics, Computer simulations, Monte Carlo, a few examples of main applications.	Chemistry building SR 102
21.02.2012			
14:00-18:00	J. Haase	Spin Physics: Origin of magnetic moments, spin (main experimental evidence) spin current (magnons), magnetic resonance. Light phenomena.	Chemistry building SR 102

Didactic elements:
Lecture, discussions, practical training – lab demonstration, etc.

Expected performance:
Active participation in discussions during lab demonstration etc.