Lectures with Nano-Background

Chemistry:

No	Titel	Content
12220-01	Supramolecular chemistry (VTV) (2 KP FS)	Introduction to supramolecular chemistry□The forces of supramolecular chemistry□Supramolecular chemistry in action□Biological inspiration□Molecular machines□Supramolecular photochemistry□From supra to nano
21525-01	Introduction to Protein NMR spectroscopy (VTV) (1 KP HS)	instrumentation; labeling techniques and sample preparation; water suppression techniques; standard 2D and 3D(4D) pulse sequences for backbone and sidechain assignment; structure determination by NMR; relaxation and dynamics; residual dipolar couplings; paramagnetic relaxation enhancement; pseudo-contact shifts; protein-ligand and protein-protein interactions; techniques for large proteins.
11830-01	Computational Chemistry: Atomistic Simulations of Proteins and Macromolecules (VTV) (3 KP FS)	The investigation of the structure, energetics and dynamics of catalytic reactions is of fundamental importance in chemistry, biology and nanotechnology. In this lecture computational techniques, including density functional theory and atomistic force fields, are introduced to characterize and quantitatively describe reactions in simple and complex systems. The lecture material is augmented by practical exercises at the computers and a small project that accompanies the students throughout the semester.
12217-01	Macromolecular chemistry (VTV) (4 KP FS)	polymerization reactions, conformation of macromolecules, statistical chain models, thermodynamics of macromoleculs in solution, characterization techniques, structure-property relationships in macromolecular systems
19302-01	Synthesis and physical properties of nanoscale systems, part II (3 KP, HS)	The lecture deals with current developments of nanoscale systems. A particular focus is set on the synthesis of molecular building blocks and their integration in larger functional devices. Furthermore, the working principles of molecular devices will be discussed in details.

Physics

These lectures are offered in general once a year or even more seldom

12303-01	Vorlesung: Electronic structure and atomistic simulations (2 KP, sporadic)	Methods for electronic structures calculation such as density functional theory. Configuration interaction methods and

		Quantum Monte Carlo and their application in atomistic simulations.
19604-01	Vorlesung: Hydrodynamics: Introduction of the programming of parallel computers in Fortran (2 KP, sporadic)	Foundations of hydrodynamics and applied numerical methods. Programming in Fortran 90. Pragmatic use of parallel computers to simulate dynamic processes.
11287-01	Vorlesung: Advanced quantum mechanics (4 KP, FS)	Relativistic wave equations, Klein-Gordon and Dirac equation, classical field theory, quantum field theory, Noether theorem and symmetries.
11705-01	Vorlesung: Superconductivity: Theory and experiment (2 KP, sporadic)	Occurrence of superconductivity, microscopic mechanism, new materials, new methods
12293-01	Vorlesung mit Übungen: Application of methods of Theoretical Physics in industry (2 KP, FS)	Optimization of energy / power devices; Special theoretical methods for modelling complex systems.
21388-01	Vorlesung mit Übungen: Introduction to magnetism and magnetic materials (4 KP, sporadic)	Introduction to magnetism and magnetic materials
19300-01	Vorlesung mit Übungen: Random processes: Theory and applications from physics to finance (4 KP,)	Basics of probability theory; Random processes: General concepts; Markov processes: Master equation, Fokker-Planck equation, stochastic differential equations; Mathematical finance
12305-01	Proseminar: Electronic structure calculations (4 KP, weekly)	The students give a presentation on a topic which is related to the content of the electronic structure course but which was not covered in this course
21325-01	Proseminar: Theoretische Physik: Condensed Matter Field Theory (4 KP)	Each year, a different topic of modern condensed matter theory is chosen. The students give talks on this topic and write a short report.
11695-01	Projekt: Synchrotron radiation project (2 KP, sporadic)	Typical experiments using a modern synchrotron radiation source
12304-01	Übung: Electronic structure and atomistic simulations (2 KP, sporadic)	Exercise class
11288-01	Übung: Advanced quantum mechanics (FS)	Exercise class
11694-01	Praktikum: Applications of	Introduction of neutron activation

	neutron activation analysis for students of natural sciences (2 KP, each semester)	analysis(NAA) in theory and practical work. The focus is on the application of gamma-spectrometry. Basic facts of nuclear physics relevant for NAA.
11699-01	Praktikum: Advanced Lab experiments (2 KP, each semester)	Students perform advanced Lab experiments under individual guidance.
12267-01	Praktikum: Radiophysical Lab course for advanced students (4 KP, FS)	6 small experiments using nuclear physics measurement methods
22638-01	Vorlesung: Monte-Carlo Methods in Physics (2 KP, sporadic)	Random numbers and how to create them. Pseudo- and Quasi random numbers. Monte Carlo integration methods and their optimization. Markov Processes und Markov Chain Monte Carlo methods. Application to the solution of physical problems.
22774-01	Vorlesung: Introduction to Nanomechanics (2 KP, sporadic)	The main topics to be covered include: from atomic chains to 3D lattices, phonons, stress and strain, elasticity, static and dynamic behavior of solids, dissipation and noise in mechanical systems, experimental nanostuctures, nanostructure fabrication, ultrasensitive force microscopy, resonator cooling, magnetic resonance force microscopy.
11680-01	Vorlesung: Computational Physics (4 KP,sporadic)	Numerical methods to solve problems in the traditional areas of physics are covered. Topics include Molecular Dynamics, Monte Carlo methods, the evaluation of 1/r potentials, global geometry optimization and methods to solve the one-electron Schroedinger equation. Also covered are topics in floating point arithmetic and basic numerical topics such as finite differences and minimization methods. A brief introduction is given to the Fortran Programming language.
15437-01	Vorlesung: Introduction to Molecular Elektronics (3 KP, HS)	
15466	Vorlesung: Introduction to Mesoskopic Physics und Quantum Dots (2KP,sporadic)	semiconductor bandstructure, surfaces and interfaces, 2D electron gases, nano sample fabrication, low temperature techniques, concepts

		of mesoscopic physics, quantum Hall effect, quantum point contacts, quantum dots, conductance fluctuations, quantum phase coherence, weak localization and antilocalization, Coulomb blockade, Kondo effect, few electron dots, spin blockade, spin relaxation, charge sensing, spin manipulation and coherence, nuclear spins, electron spin resonance, Spin qubits, quantum computation
20576	Vorlesung: Patenting of research results Physics and Nanoscience (1 KP, sporadic)	Basic facts about how to obtain patents for research results.
15435-01	Vorlesung mit Übungen: Research using synchrotron radiation (2 KP, HS)	Principles of synchrotron radiation sources, typical experiments
19576-01	Vorlesung mit Übungen: Surface physics (4 KP)	The course will treat surface analysis methods like LEED, Auger, XPS, UPS, mass spectroscopy, EELS, FIM, STM, AFM, as well as the most important preparation methods for ultrahigh vacuum systems..
11686	Vorlesung mit Übungen: Theoretical condensed matter physics (6 KP, HS)	The lecture is an introduction into the concepts of modern condensed matter physics rather than a lecture of traditional solid state physics. The topics include: Second quantization, the Keldysh technique for Green's functions, Feynman diagrams, linear response theory, transport in mesoscopic systems, mean field theories (mainly for magnetism), and the Kondo problem.
11681	Praktikum: Computational Physics (2 KP, HS)	exercise classes