UNIVERSITÄT LEIPZIG

Leipzig University

Semester 2 syllabus

Course catalog	ECTS
Physical Organic Chemistry	5
Structural Inorganic Chemistry	5
Synchrotron Radiation and its Applications	5
Highlights in Natural Products Synthesis	5
Modern Concepts in Catalysis	5
Modern Methods in Theoritical Chemistry	5
NMR on Biosystems	5
Recent Trends in Chemistry	5
Receptor Biochemistry	5
Selected Topics of NMR Spectroscopy	5
Separation Techniques and Advanced "-omics" Techniques	5
Spectroscopy	5
Surface Spectroscopy - Methods and Application	5

Mandatory courses

Elective courses: 3 to choose

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Course title	STRUCTURAL ANALYSIS IN INORGANIC CHEMISTRY		
Information	Number of credits: 5 ECTS	Number of taught hours 60 h lectures	Number of hours expected of student personal work: 90 h
Synopsis	X-ray structural analysis: basics of crystallography, X-ray diffraction at crystals, symmetry (Point groups and space symmetry), structure factors, Fourier-Synthesis, experimental methods, structure determination and refinement, phase problem; results and interpretation of single-crystal X-ray analysis; data bases and software systems. IR spectroscopy: basics, forecast of spectra, selected examples. NMR spectroscopy: basics, hetero cores (e.g. 19F, 31P, 207Pb, 119Sn), selected examples. Magnetochemistry: molecular magnetism, magnetic susceptibility, magnetic properties of coordination compounds, "spin-only" magnetism, magnetic exchange interaction, single-molecule magnets		
Learning outcomes / skills and competencies	After completing this unit the student should be able to: know modern structural-analytical methods for the characterization of inorganic compounds.		
Teaching staff and contact email	Prof. Dr. Harald Krautscheid: krautscheid@rz.uni-leipzig.de		
Examination			

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Course title	SYNCHROTRON RADIATION AND ITS APPLICATIONS		
Information	Number of credits: 5 ECTS	Number of taught hours 44 (online module)	Number of hours expected of student personal work: 81 h
Synopsis	The aim of this unit are: - to provide the students with a broad overview of different analysis techniques using synchrotron radiation - to develop the skills of the students to elucidate electronic and geometric structure elucidation of the matter by applying various complementary spectroscopies using synchrotron radiation source - to highlight modern advances in instrumentation and analysis techniques within synchrotron radiation field. Part I : Synchrotron radiation and interaction of the matter with light Part II : Core level spectrosocopies using synchrotron radiation Part III: other spectroscopies using synchrotron radiation		
Learning outcomes / skills and competencies	At the end of the course, the student will understand the basic notions regarding the principal spectroscopic experimental techniques based on synchrotron radiation sources, with emphasis on the underlying chemistry. The student will learn the essentials of the X-ray experimental methods such as X-Ray diffraction, X-ray absorption spectroscopy, X-ray fluorescence, and photoemission.		
Teaching staff and contact email	Asma Tougerti: asma.tougerti@univ-lille.fr Eric Marceau: eric.marceau@univ-lille.fr Sylvain Cristol: sylvain.cristol@univ-lille.fr Reinhard Denecke: denecke@uni-leipzig.de Marco Giorgetti: marco.giorgetti@unibo.it		
Examination			

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Course title	HIGHLIGHTS IN NATURAL PRODUCTS SYNTHESIS		
Information	Number of credits: 5 ECTS	Number of taught hours 45 h lecture, 15 h seminar	Number of hours expected of student personal work: 90 h
Synopsis	Natural products are an inspiring source for organic chemistry. Their unique structure as well as biological activity make them ideal targets for synthetic studies. In this course a broad range of different natural products with significant biological activities will be discussed with respect to their structure, biological activity and synthesis (prostaglandins, alkaloids, macrolides, steroids, terpenes). A major focus will be on the retrosynthesis of the target molecule, that is identification of suitable bond disconnections to form smaller compounds which are more easily assembled. The students will learn how to plan a complex total synthesis of a given structure.		
Learning outcomes / skills and competencies	The aims of this unit are: learning from famous total syntheses of natural products the students shall be able to apply retrosynthesis considerations for syntheses of complex organic molecules. After completing this unit the student should be able to: cope with theoretical dissection of molecules into retrons; understand advanced organic synthetic methods.		
Teaching staff and contact email	Prof. Dr. Christoph Schneider: chschnei@uni-leipzig.de		
Examination			

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Course title	MODERN CONCEPTS IN CATALYSIS		
Information	Number of credits: 5 ECTS	Number of taught hours 30 h lecture, 30 h exercise	Number of hours expected of student personal work: 90 h
Synopsis	Kinetics of catalytic reactions, catalyst characterisation, solid state catalysts, surface reactivity, micro kinetic modelling, practical applications		
Learning outcomes / skills and competencies	The aims of this unit are: understanding and applying basic concepts in catalysis. After completing this unit, the student should be able to cope with: Knowledge of catalyst structures and composition, concepts of catalytic reactions and their kinetics.		
Teaching staff and contact email	Prof. Dr. Roger Gläser: roger.glaeser@uni-leipzig.de		
Examination			

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Course title	MODERN METHODS IN THEORITICAL CHEMISTRY		
Information	Number of credits: 5 ECTS	Number of taught hours 60 h	Number of hours expected of student personal work: 90 h
Synopsis	Methods to treat electron correlation (Post-Hartree-Fock methods, Density functional theory), Methods to calculate very large systems, supercell approaches to calculate periodic structures, methods to treat dynamic processes.		
Learning outcomes / skills and competencies	After completing this unit, the students should know modern methods of Theoretical Chemistry.		
Teaching staff and contact email	Prof. Dr. Ralf Tonner-Zech: ralf.tonner@uni-leipzig.de		
Examination			

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Course title	NMR ON BIOSYSTEMS		
Information	Number of credits: 5 ECTS	Number of taught hours 30 h lecture, 15 h seminar, 15 h practical	Number of hours expected of student personal work: 90 h
Synopsis	After a repetition of the basics of 1D NMR spectroscopy the principles of 2D NMR will be explained and in part described mathematically. The main part of the lecture course is the description of different 2D NMR methods for structural elucidation, such as J-resolved spectroscopy, COSY, H,C correlation (HMQC, HMBC) as well as NOESY, TOCSY and ROESY. The theoretical lectures of the course are accompanied by practical demonstrations and accompanied by a homework assignment. The practical demonstrations yield a set of spectra for a somewhat more difficult compound. This structure has to be elucidated and a written protocol is required. A final written test will be performed at the end of the lecture course.		
Learning outcomes / skills and competencies	The aims of this unit are: - To build upon and extend the theoretical and instrumental concepts of Magnetic Resonance introduced during the bachelor degree programme. - To develop the competence and confidence of the students applying Magnetic Resonance towards structural elucidation After completing this unit the student should be able to: -Understand in a comprehensive way the pulse programs for 2D NMR spectroscopy -Identify and apply methods for structural elucidation in bioorganic chemistry -Interpret 2D NMR spectral data and present the conclusions drawn in written and oral form		
Teaching staff and contact email	Prof. Dr. Jörg Matysik: joerg.matysik@uni-leipzig.de		
Examination			

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Course title	RECENT TRENDS IN CHEMISTRY		
Information	Number of credits: 5 ECTS	Number of taught hours 30 h lecture, 15 h seminar, 15 h practical	Number of hours expected of student personal work: 90 h
Synopsis	This module course is consisting of independent lectures by different (international) scholars in English. Contents will be communicated per semester.		
Learning outcomes / skills and competencies	The students shall be able to understand, discuss and present science topics from current research fields in chemistry		
Teaching staff and contact email	Prof. Dr. Jörg Matysik: joerg.matysik@uni-leipzig.de		
Examination			

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Course title	RECEPTOR BIOCHEMISTRY		
Information	Number of credits: 5 ECTS	Number of taught hours 30 h lecture, 30 h exercise	Number of hours expected of student personal work: 90 h
Synopsis	The main classes of receptors, their function and their biologically relevant ligands are discussed and. methods of medicinal chemistry for the development of drugs are shown. The basics of signal transduction in cells and the most relevant test systems to understand binding and function of receptors are explained. Recent high throughput systems are demonstrated. The receptor families contain nuclear receptors/steroid receptors, G-protein coupled receptors, ligand gated ion channels, receptor tyrosine kinases and transporter proteins.		
Learning outcomes / skills and competencies	The aims of this unit are: Understanding structure, function and activation of receptors and their signal transduction mechanisms. After completing this unit the student should be able to cope with: signal transduction, receptor biochemistry, G-proteins, protein ligand interaction.		
Teaching staff and contact email	Prof. Dr. Anette Beck-Sickinger: abeck-sickinger@uni-leipzig.de		
Examination			

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Course title	SELECTED TOPICS OF NMR SPECTROSCOPY		
Information	Number of credits: 5 ECTS	Number of taught hours 30 h lectures, 15 h practicals	Number of hours expected of student personal work: 80 h
Synopsis	The module contains specialized lectures with the following contents: - Product Operator Formalism - 2D NMR Spectroskopy - NMR Spin-Systems - Dynamic NMR - Weakly-oriented molecules - Solid State NMR of seelcted NMR cores - Hyperpolarisation - NMR with pulsed field gradients		
Learning outcomes / skills and competencies	The students will obtain a deep understanding of special NMR methods.		
Teaching staff and contact email	Prof. Dr. Jörg Matysik: joerg.matysik@uni-leipzig.de		
Examination			

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Course title	SEPARATION TECHNIQUES AND ADVANCED "-OMICS"-TECHNIQUES		
Information	Number of credits: 5 ECTS	Number of taught hours 30 h lectures, 30 h seminar including presentation	Number of hours expected of student personal work: 90 h
Synopsis	The identification and quantification of multiple substances in complex sample mixtures, like body fluids, demands the combination of multiple separation techniques with mass-spectrometric methods. The module treats regularly used separation technqiues with high resolution including multi-dimensional chromatographic and electrophoretic separations. The possibilities and requirements of these techniques in combination with fast high-resolution mass spectrometers are extensively demonstrated and discussed with examples from Proteomics, Lipidomics, Peptidomics and Metabolomics.		
Learning outcomes / skills and competencies	After completing this unit, the students should know modern analytical high-throughput methods to identify and quantify complex sample mixtures as part of "hypothesis-free" and "hypothesis-driven" research routes and are able to report profoundly.		
Teaching staff and contact email	Prof. Dr. Ralf Hoffmann: Ralf.hoffmann@bbz.uni-leipzig.de		
Examination			

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Course title	SPECTROSCOPY		
Information	Number of credits: 5 ECTS	Number of taught hours 60 h lecture with demonstration	Number of hours expected 90 h
Synopsis	- Introduction and history - Absorption and emission of radiation - Structure and symmetry - Nuclear magnetic resonance - Electron paramagnetic resonance - IR, Raman and UV/VIS spectroscopy - Laser and NLO effects in spectroscopy - X-ray and photoelectron spectroscopy - Moessbauer spectroscopy - Mass spectroscopy		
Learning outcomes / skills and competencies	Broad overview for all relevant spectroscopic methods. After completing this unit the student should be able to cope with: Spectroscopic theory, selection of spectroscopic techniques for a given problem, applying spectroscopic techniques for scientific questions.		
Teaching staff and contact email	PD Dr. Marko Bertmer: bertmer@physik.uni-leipzig.de		
Examination			

UNIVERSITÄT LEIPZIG

Course title	SURFACE SPECTROSCOPY - METHODS AND APPLICATIONS		
Information	Number of credits: 5 ECTS	Number of taught hours 45 h	Number of hours expected 105 h
Synopsis	Introduction to structure of solid surfaces and interfaces. Physical basics, instrumentation and application examples of surface analysis methods: electron spectroscopy: Photo (XPS, UPS) and Auger electron spectroscopy (AES), energy loss spectroscopy (EELS), Quantitative lateral distributions and depths profile analysis oft he chemical state; Electron diffraction (LEED,XPD); Secondary ion mass spectrometry (SIMS, SNMS). Applications: Adsorption, Desorption, Catalysis, Thin film growth and Segregation.		
Learning outcomes / skills and competencies	The students will know rules and laws in context with the solid surface structure, the gas-sold interaction and the thin film growth. They will know important techniques of surface analysis and can compare and evaluate them.		
Teaching staff and contact email	Prof. Dr. Reinhard Denecke: denecke@uni-leipzig.de		
Examination			