UNIVERSITY OF HELSINKI

University of Helsinki

Semester 3 syllabus

Course catalog	ECTS
Internship and Transferrable Skills	10
Basics of Atmospheric Chemistry	5
Laboratory Practicum in Polymer Chemistry	5
Laser Spectroscopy Instrumentation	5
Laser Spectroscopy	5
Materials Characterization	5
Radiochemistry	5
Separation Techniques	5
Structure and Reactivity - Organic Reactions	5

Mandatory

Elective courses: 20 ECTS to choose

Additionally or alternatively several other elective studies are possible.
For a complete list of courses, see: https://studies.helsinki.fi/instructions/article/structure-and-scope-degree-programme

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Course title	BASICS OF ATMOSPHERIC CHEMISTRY		
Information	Number of credits: 5 ECTS	Number of taught hours Weekly lectures and exercises (individual work, with some pair or group work during lectures) Presentation (group work) Laboratory visits (group work) Exercise and poster workshops once or twice during the course to support students.	Number of hours expected of student personal work: 135 h
Synopsis	The course covers the following topics: - Unifying and common concepts in atmospheric chemistry - Atmospheric composition, and concentration unit conversions - Thermodynamic and kinetic tools needed in atmospheric chemistry - Elemental cycles of N, C, O, H and S - Key features of stratospheric (ozone) chemistry - Key features of tropospheric (radical oxidation) chemistry, including air pollution		
Learning outcomes / skills and competencies	The basic concepts and unifying features of atmospheric chemistry, including the concept of oxidation and the relationship between altitude, chemical energy and chemical complexity. Ability to apply kinetic and thermodynamic tools to solve simple atmospheric chemical problems.		
Teaching staff and contact email	Theo Kurten, Matti Rissanen: theo.kurten@helsinki.fi		
Examination			

UNIVERSITY OF HELSINKI

Course title	LABORATORY PRACTICUM IN POLYMER CHEMISTRY		
Information	Number of credits: 5 ECTS	Number of taught hours 10 full days of practical work (about 60-70 h)	Number of hours expected of student personal work: 135 h
Synopsis	Participants will synthesize polymers and will be familiarized with the most common methods of basic characterization of polymers. Students will also use more advanced techniques to study physicochemical properties of polymers. Demonstrated methods and instruments are those that are used nowadays in science and industry.		
Learning outcomes / skills and competencies	All possible opportunities for personal initiative during lab works are provided. Participants have the possibility to test their future profession in practice.		
Teaching staff and contact email	Vladimir Aseyev: Vladimir.Aseyev@helsinki.fi		
Examination			

UNIVERSITY OF HELSINKI

Course title	LASER SPECTROSCOPY INSTRUMENTATION		
Information	**Number of credits:** 5 ECTS	**Number of taught hours** Lectures/tutorials twice a week. Weekly home exercises.	**Number of hours expected of student personal work:** 135 h
Synopsis	The following topics are covered: - Properties of laser light and laser beam propagation - Optical resonators and their use in molecular spectroscopy - Principles of lasers and different type of lasers for spectroscopy - Control and modulation of laser light - Application examples in optical spectroscopy		
Learning outcomes / skills and competencies	After completing the course, the students will have basic knowledge of lasers and other photonics components and instruments used in modern optical spectroscopy. This course is recommended prior to taking "Laser Spectroscopy", which focuses on laser spectroscopic methods and applications.		
Teaching staff and contact email	Markku Vainio: markku.vainio@helsinki.fi		
Examination			

UNIVERSITY OF HELSINKI

Course title	LASER SPECTROSCOPY		
Information	**Number of credits:** 5 ECTS	**Number of taught hours** Weekly lectures/tutorials. 3 to 5 laboratory exercises (3 h each + reports; done as group work).	**Number of hours expected of student personal work:** 135 h
Synopsis	The following topics are covered: - Fundamentals of molecular absorption spectra and spectral lineshapes - Tuneable laser absorption spectroscopy, spectroscopic databases, trace gas quantification - Frequency-modulation laser spectroscopy - Photoacoustic spectroscopy - Multipass methods and cavity-enhanced laser spectroscopy - Examples of applications of laser absorption spectroscopy		
Learning outcomes / skills and competencies	After completing the course, the students will master the most important experimental methods of laser absorption spectroscopy used in (i) fundamental research of molecular spectroscopy and (ii) analytical chemistry.		
Teaching staff and contact email	Markku Vainio: markku.vainio@helsinki.fi		
Examination			

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Course title	MATERIALS CHARACTERIZATION		
Information	Number of credits: 5 ECTS	Number of taught hours Weekly lectures	Number of hours expected of student personal work: 135 h
Synopsis	The course covers the following topics: - Optical methods in materials characterization - Non-destructive ultrasonic-testing - Introduction to Scanning Electron Microscopy and Transmission Electron Microscopy - Fundamentals of X-ray scattering, imaging and X-Ray Diffraction - Infra-Red Spectroscopy and Raman probes - Nuclear Magnetic Resonance spectroscopy - Thermal analysis; Differential Scanning Calorimetry - Light scattering for particle characterization - Scanning probe microscopies; Atomic Force Microscope, Scanning Tunneling Microscope - Electrical characterization - Surface analysis by X-ray Photoelectron Spectroscopy and Auger Electron Spectroscopy, Secondary Ion Mass Spectrometry Ion beam based techniques		
Learning outcomes / skills and competencies	The students will have an understanding of the principles, capabilities and limitations of some of the most important materials characterization methods, and be able to identify suitable methods for particular problems.		
Teaching staff and contact email	Filip Tuomisto: filip.tuomisto@helsinki.fi		
Examination			

UNIVERSITY OF HELSINKI

Course title	RADIOCHEMISTRY		
Information	**Number of credits:** 5 ECTS	**Number of taught hours** Two-hour lectures three times a week, total 42 h + exercises.	**Number of hours expected of student personal work:** 135 h
Synopsis	Types of radioactive nuclides and radioactive decay will be covered, as well as interaction processes of radiation with matter. Detection and measurement of gamma, beta and alpha emitting radionuclides with solid and liquid scintillation detectors, with gas ionization detectors and with semiconductor detectors will be discussed along with radiation imaging. Radiation safety will also be covered, including biological effects of radiation, radiation safety legislation and guidelines, as well as management and disposal of radioactive waste.		
Learning outcomes / skills and competencies	The course offers basic knowledge on nuclear physics, on radioactive decay phenomenon, on the detection and measurement of radiation and on radiation safety.		
Teaching staff and contact email	Gareth Law, Risto Koivula: gareth.law@helsinki.fi		
Examination	Two exams, one on radiation safety and the other on radioactive decay and on the detection and measurement of radiation.		

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Course title	SEPARATION TECHNIQUES		
Information	Number of credits: 5 ECTS	Number of taught hours 36 h lectures + presentations, demonstration, exercises and student's independent learning.	Number of hours expected of student personal work: 135 h
Synopsis	The course provides an introduction to modern gas, liquid and supercritical chromatography. The scope of the course is to provide insight into the chromatographic theory with special emphasis on the determination and use of different parameters in chromatography, and especially on an understanding of these parameters in optimal chromatographic separations. The instrumental part will comprise injection techniques, column characteristics and selection, and different detection systems.		
Learning outcomes / skills and competencies	Student will learn: - The basic theory and principles of gas chromatography, supercritical chromatography and different liquid chromatographic techniques - Different parameters affecting the separations - Selection of optimum parameters and columns for successful separations - Application areas		
Teaching staff and contact email	Marja-Liisa Riekkola: marja-liisa.riekkola@helsinki.fi		
Examination			

UNIVERSITY OF HELSINKI

Course title	STRUCTURE AND REACTIVITY - ORGANIC REACTIONS		
Information	Number of credits: 5 ECTS	Number of taught hours Weekly lectures and exercises	Number of hours expected of student personal work: 135 h
Synopsis	The course covers the following topics: - Strain and stability - Acidity and basicity - Thermodynamics and kinetics of organic reactions - Mechanisms of organic reactions and how to study them - Structure and reactivity: Linear free energy relationships - Activation control: transition state theory and activation parameters		
Learning outcomes / skills and competencies	The students should enhance their knowledge and ability to: - Consider the physical and structural factors steering the reactivity of organic compounds - Evaluate the structure, stability and function of reactive intermediates (ions, radicals and carbenes) - Connect the factors of chemical bonding to the physical and chemical properties of the molecules - Relate the terms acidity and basicity with the organic reactivity in a quantitative manner - Apply linear free energy relationships in equilibrium and reactivity studies - Understand the basic principles of transition state theory and using of the activation parameters - Distinguish between different reaction mechanisms on the basis of experimental data		
Teaching staff and contact email	Mikko Oivanen: mikko.oivanen@helsinki.fi		
Examination			

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Semester 4 syllabus

Course catalog	ECTS
Master Thesis	30
Nanocatalysis	5
Polymer Physics	5
Polymers in Medecine	5

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Course title	NANOCATALYSIS		
Information	Number of credits: 5 ECTS	Number of taught hours Weekly lectures, self-reading, preparation of a presentation, preparation of literature survey	Number of hours expected of student personal work: 135 h
Synopsis	The course covers the following topics: - Nanocatalysis: Background and Fundamentals - Catalytic Properties of Nanomaterials - Synthesis of Nanomaterials and Nanocatalysts - Characterization of Nanocatalysts - Case Studies: Liquid and gas-phase transformations, Electrocatalysis, Photocatalysis - Frontiers in Nanocatalysis		
Learning outcomes / skills and competencies	The students will learn the main concepts in the area of nanocatalysis, ranging from important classes of transformations to the synthesis and characterization of nanocatalysts.		
Teaching staff and contact email	Pedro Camargo: pedro.camargo@helsinki.fi		
Examination			

UNIVERSITY OF HELSINKI

Course title	POLYMER PHYSICS		
Information	Number of credits: 5 ECTS	Number of taught hours 42 h: Exercises, essays Exercises are based on homework and discussions in class.	Number of hours expected of student personal work: 135 h
Synopsis	The course provides a general introduction to the physics of polymers. Structure, conformation, and properties of polymers in solution are specifically discussed. Properties of polymers in bulk are discussed in less detail. Some important experimental techniques used to study polymers are introduced as well.		
Learning outcomes / skills and competencies			
Teaching staff and contact email	Vladimir Aseyev: Vladimir.Aseyev@helsinki.fi		
Examination	Intermediate exam and final exam The intermediate exam is organized to help students to handle course materials.		

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Course title	POLYMER IN MEDECINE		
Information	**Number of credits:** 5 ECTS	**Number of taught hours** The course includes contact lecturing, individual work and group discussions.	**Number of hours expected of student personal work:** 135 h
Synopsis	The course gives an overview on how polymers are applied and how their unique features are utilized in medical applications. Specific medical fields are highlighted, including the use of polymers in well-established applications but also in future applications.		
Learning outcomes / skills and competencies	After the course, the student: - Has an overview how polymer materials are employed in medical applications - Can interrelate polymer properties with desired actions in medical applications - Can solve problems related to the use of polymers in medical applications - Can identify the consequences of decisions and plans regarding the development of functional materials to resolve medical problems - Can deliver presentations and discuss current research topics in the field of polymers in medicine from different perspectives		
Teaching staff and contact email	Robert Luxenhofer: Robert.Luxenhofer@helsinki.fi		
Examination	Final exam on the content of lectures and student oral presentations (70%) and individual oral presentation of a critical review of assigned primary research articles (30%).		