

Environmental Chemistry and Technology

Autumn 2021

Component code	Component Title	ECTS
CT00AA26	Basic chemistry	6
<p>The objective of the course is that the student gets familiar with the basic knowledge of the general and inorganic chemistry in theory as well as the working methods and equipment used in laboratory.</p> <p>The course of basic chemistry includes: atoms and atomic structure, periodicity, chemical bonds and equilibrium, chemical reactions and reaction equations, the characteristics of acids and bases and oxidation and deoxidation reactions.</p> <p>Laboratory work include: various traditional chemical working methods, separation processes, solubilities and acid base titrations. Most of them are in micro scale.</p> <p>By working in the laboratory the student gets training in safe and careful working methods and technical reporting. He/she learns to realize the risks associated with the chemicals and to pay attention to the environmental protection.</p>		
CT00AA25	Organic chemistry	6
<p>The outcome of the course is to give students basic knowledge in organic chemistry as well as the working methods and equipment used in organic chemistry. Special attention is paid to job safety and environmental protection. Main groups of the most common organic compounds and the importance of their functional groups. The most important reaction types in organic chemistry. The content of the course is aliphatic and aromatic hydrocarbons, alcohols, phenols, ethers, sulphur compounds, aldehydes, ketones, carboxyl acids, amines, amides, amino acids. Theoretical basis of the following analysing methods: IR, NMR, GC and LC.</p>		
CT00AA31	Physical chemistry	6
<p>The outcome of the course is a student knows the gas laws, thermodynamics and thermochemistry. He can calculate reaction enthalpies and equilibria from thermodynamic data. The student knows the basics of electrical chemistry and is able to apply this information in electrolysis, corrosion prevention, coating and electrochemical measurements.</p> <p>The content of the course is ideal gas law, as well as the kinetic gas theory and equations of state, AspenTech Hysys used in applications, Thermochemistry, heat of formation, heat of reaction, Gibbs energy and Chemical equilibrium, The Ellingham diagram, The HSC-programmes are used in exercises, The migration of ions in electrochemical cells, Polarisation, Corrosion of metals and the Pourbaix-diagram.</p>		
CTK1028	Chemical reaction engineering	6
<p>After completing Chemical reaction engineering – course student, is able to choose suitable reaction types for a given function, can size the reactor and select control parameters for the given system, knows the factors that affect mechanism and rates of chemical reactions, is able to compile reaction rate equation based on test results and can utilize excel in reactor design calculations.</p>		

The content of the course is Basics of reactor design, Interpretation of batch reactor data, Single ideal reactors, Design of single reactions, Homogenous reactions in parallel, Reactions in series, Series-parallel reactions, Gas phase reactions and Heat of reaction.

CTK1042	Biotechnology	6
<p>The outcome of the course is knowing the biotechnical processes that utilise micro-organisms. Understanding the similarities and differences between the techniques of biotechnology and chemistry. Microbiology, in other words micro-organisms, their growth, conditioning, gene technology.</p> <p>The content of the course is biotechnological processes such as DNA fingerprinting, gene transformation and DNA electrophoresis.</p>		

CTK1057	Oil refining	6
<p>After the course a student should understand the importance of oil products energy source globally and in different countries, the nature and origin of crude oil, oil refining raw materials and products, the main process units and their roles in oil refineries, supporting processes needed and the future in oil refining.</p>		

CTK1060	Process simulation	6
<p>The objective of this class is to introduce the student to process modelling and to the use of computer programs for the simulation of chemical processes.</p> <p>The content of the course is Mathematical models of chemical processes, Different types of simulation programs, Creating models of different processes using a modular simulation program and trying "what-if" improvements to the process, The use of modular simulation programs in the design and analysis of chemical processes and Aspen Hysys is the main simulation program.</p>		

CTK1068	Basics of environmental protection	6
<p>The objective of the course is to give the student basic knowledge of environmental problems and possibilities of environmental protection. The student will become familiar with the central facts of ecology and natural resources.</p> <p>The content of the course is ecological systems and their functions, raw materials and energy, sustainable development, life-cycle analysis and environmental management will be discussed.</p>		

CTK1043	Cleaning techniques	5
<p>After completing Ecology and cleaning techniques – course student can explain the basics of pollution and knows the importance of sustainability, knows the possibilities of environmental technology to reduce pollution, is able to name and identify harmful emissions in soil, water and air, and is able to recognize the sources of emissions, can describe health and environmental effects of pollutants, can identify and describe the methods used in environmental technology: Pollution prevention and different abatement techniques (primary and secondary methods), can choose the best available technology for each case, can explain the principles of green chemistry and green engineering and can apply those principles in process design, understands the circulation economy and its importance as an operating model of the future, learns to know the importance of environmental catalysis and knows principles of LCA.</p>		

The content of the course is Basics of pollution, Green chemistry and Circular economy, LCA, Environmental catalysis, Air emissions and purification methods, Water and waste water treatment, Soil remediation, Hazardous waste treatment techniques and Modern landfills.

CTK1034	Laboratory exercises in chemical engineering	6
<p>The student is able to apply the information learned in the advanced course of process design and development in practise, mainly in pilot scale equipment. He also learns to evaluate to a deeper level compatibility of the measured values and differences from theory.</p> <p>The exercises will be done in groups of 2-4 students. Each student will compile an individual report of the experiments' results. Handling the measured values (calculation, tables, and graphical presentations) can, however, be mutual in the group. Subjects for the exercises: distillation, absorption-desorption, flooding points in columns, liquid-liquid-extraction, heat exchange, evaporation, fluidization, mixing.</p>		

Spring 2022

Component code	Component Title	ECTS
TCTK058	Environmental administration and legislation	6
<p>The objective of the course is to give the student a general view of the administration and legislation of Finnish environmental protection, including different plans, permits and other ways of control.</p> <p>The course will review the Finnish administration structure of environmental protection with its different levels (nation, area, municipal) and the distribution of tasks to different authorities. The tasks of judicial and administrative authority will also be dealt with. The ways of control on administrative level (notices, permits, supervision) will be reviewed. When reviewing the different notices and permits, the administrative practice and applications, ways of processing and ways of monitoring that are connected with the permits will be reviewed. An emphasis will be put on the flexible handling of the permits and the joint and simultaneous handling of permits. Also, the petitioning systems connected with the permits will be reviewed.</p>		
CTK1062	Chemical engineering project	6
<p>Students learn to understand the different phases of organised project management based on complex problems in multi-field projects. Students are able to identify the unit processes handled in the project and their principles of operation and they learn how to handle issues related to flow dynamics. Finally, students are able to document the results of the project using computers.</p> <p>Content of the course: Choosing and organizing the project, planning and dividing the project into subprojects, project scheduling, closing the project, using digital devices in project control, individual and group computer exercises. Contents include exercises from chemistry and chemical engineering and computer documentation.</p>		
CTK1033	Mass transfer	6
<p>The outcome of the course is a student is able to deal with the exercises of equilibrium between phases and apply the knowledge in the mass transfer processes.</p> <p>The content of the course is Gibb's phase rule and phase equilibrium drawings in one component systems and the mathematical handling of phase equilibrium of different phases of the same substance, The vapor-liquid-equilibrium (VLE) pictures of binary mixtures in both ideal and real cases and their application in simple distillation, The construction of VLE drawings. Different types of physical state drawings of binary condensed systems and their meaning, The colligative properties of liquids and their mathematical handling, The most important legalities of the solubility of gases, The utilising databases in phase equilibrium problems. The course will emphasise the following unit operations of mass transfer: distillation, absorption, liquid-liquid-extraction, dissolving solids, crystallisation, handling humid gases, drying, adsorption, ion exchange.</p>		
CT00AA29	Mechanical operations	6
<p>The outcome of the course is a student knows the basic information and methods of granular materials, estimation techniques for granular size, disintegrating materials, sieving, classification and concentration methods of minerals.</p> <p>The course includes three laboratory exercises on crushing, grinding, sieving, classification and mixing. The student is able to apply the knowledge gained in the basic course of process design in practise mainly with the pilot scale equipment. He also learns to evaluate in writing the</p>		

compatibility of the measuring results and differences from theories. The student understands the central role of filtering, sedimentation, mixing in process industry as well as the most common equipment used, their advantages and disadvantages and the most important dimensioning principles. Most common filter devices, filtering theory, centrifugal filtering, thickeners, theory of settling and dimensioning equipment. The most common mixing devices. The most common concentration methods of minerals: flotation and magnetic separation.

CTK1039	Environment and energy	6
<p>The outcome is to give a student basic knowledge of the impact of consumption of energy and production on environment, the problems they cause and the solution possibilities.</p> <p>The content of the course is energy production and energy consumption, energy resources, annealing and their effects, purifying methods, boosting methods of energy use.</p>		

CTK1063	Wood chemistry	5
<p>The content of the course is the structure of wood, chemistry of wood compounds, the bark of the tree and its chemistry, the chemical structure of wood and bulk, lignin, cellulose, hemicellulose, extract substances, the chemistry of cooking and bleaching, cellulose derivatives.</p>		

CT00AA32	Heat and energy techniques	6
<p>After the course a student comprehends basic concepts of heat transfer and energy conservation laws and understand the mechanisms of heat transfer. The student is able to calculate the amount of heat transferred and the heat flux in different cases, name and select the appropriate heat exchanger for the process, dimensions the heat exchanger. It also explains common forms of energy production and power plant processes as well as steam production, steam boilers and fluidized beds.</p>		

CTK1061	Chemistry project	4
<p>The outcome of the course is a student knows the basic skills in project based and problem-based learning. A student also understands the significant (especially local) processes in the process industry and their relation to inorganic and organic chemistry.</p>		

CT00AA24	Applied chemistry	5
<p>The outcome of the course is to supplement the knowledge of the general chemistry and to give the student the basic knowledge needed about inorganic chemistry. With the help of this basic information the student understands that chemistry is an essential part of process industry and analytics. The course acquaints the student with independent information search from literature and preparing short written reports.</p> <p>The content of the course is chemical equilibrium, thermodynamics, acids and bases, redox reactions and electrical chemistry. Special attention is paid to the features of inorganic compounds, occurrence in nature and use in industry. A short survey of the central chemical processes of Finnish process industry. The manufacture of basic chemicals, metallurgical industry, food industry.</p>		

TL1040	Entrepreneurship	3
<p>Making a Business Plan individually or in a group.</p>		

CTK1058	Biofuel production	6
<p>After taking the course, the student will be able to know and identify the most important biofuels and biomasses and their physical and chemical properties for energy conversion, recognize and understand various energy conversion and combustion technologies needed for the use of bioenergy in power generation and transport, calculate and evaluate the most important energy conversion parameters in boilers and engines, related to biofuels and biomass.</p>		
CTK1044	Design of water and waste water plants	5
<p>The outcome of the course is that a student knows how to design Water plants and Waste water plants. Hence, the prerequisites are competence in chemistry, competence in processes, competence in environment, quality and safety, working community competence and innovation competence.</p>		