centria
University of Applied Sciences

Environmental Chemistry and Technology

Autumn 2022

Component code	Component Title	ECTS

CT00AA26	**Basic chemistry**	6
Content: structure of the matter, phases, periodic table, character of matter and chemical bonding, stoichiometry of chemical reactions (chemical equilibrium, acid-base -, redox -, precipitation reactions), phase changes, gas laws, concentration calculations. Learning targets: The student can apply and estimate the values of results for both theoretical tasks and laboratory tasks. The student knows how to use different information sources critically. The student knows basic problem solving. The student can plan and evaluate their own work in laboratories (e.g., choosing equipment).		

CT00AA25	**Organic chemistry**	6
Content: empirical formula, molecular formula and structural formula, naming and categorizing the compounds, reaction types (esterification, substitution-, addition- elimination- and condensation), getting familiar with instrumental analytics (UV-Vis, IR) Learning targets: The student understands the basic principles of organic chemistry, is capable to determine the concepts, knows the structures of molecules and the typical reactions and analysis methods and can apply what she/he has learned.		

CT00AO38	**Analytic chemistry**	6
Content: The terms and measurements related to basic analytics, sampling and the analysis process, solvent chemistry, different analysis methods (titrimetric, gravimetric and volumetric analysis, precipitation), buffer solutions and the concept of pH, instrumental analytics in theory and practice (UV-Vis, AAS, GC) Learning targets: The student is capable to plan and get laboratory work done, evaluate the results and the reliability of them. Student understands the meaning of analytics in process technic.		

CT00AA31	**Physical chemistry**	6
Content: The basics of kinetic and thermodynamics, electrical chemistry, calculations involving gases, equilibrium of phases, lab works. Learning targets: The student recognizes and is capable to connect the basic information of physical chemistry with the contents of process technic (heat- and energy technic, mass transfer, chemical reaction technic). The student knows the laws of physical chemistry.		

CTK1028	**Chemical reaction engineering**	6
Content: History of reaction technology and use of modern design tools in reactor sizing. Determination of the reaction rate equation based on experimental data. Kinetics of homogeneous reactions. Ideal reactor types, properties, and sizing. Effect of complex side and multiple reactions. Gas phase reactions with change in molar number. Considerations of reaction heat and heating and cooling. Learning targets: The student learns the factors influencing the mechanisms and rates of chemical reactions and is able to draw reaction rate equations based on experimental results. The student acquires basic knowledge and skills in using three types of reactors for different needs in the chemical industry; batch reactor, plug flow reactor and continuous stirred-tank reactor. After the course student has skills to choose a suitable reactor for different reaction conditions and to dimension the reactor and choose the running parameters.		

CTK1042	**Biotechnology**	5
The content of the course is biotechnological processes such as DNA fingerprinting, gene transformation and DNA electrophoresis. Learning targets: The outcome of the course is knowing the biotechnical processes that utilize 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.		

CTK1057	**Oil refining**	5
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.		

CTK1060	**Process simulation**	5
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. 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 Aspentec Hysys is the main simulation program.		

CTK1043	**Cleaning techniques**	5
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.

CTK1034	**Laboratory exercises in chemical engineering**	4
The student is able to apply the information learned in the advanced course of process design and development in practice, mainly in pilot scale equipment. He also learns to evaluate to a deeper level compatibility of the measured values and differences from theory. 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.		

CT00AA32	**Heat and energy techniques**	5
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, dimens 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.		

CT00AQ32	**Environmental Monitoring**	5
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. The release of chemicals and heavy metals into the environment and their behavior in nature. Environmental measuring. Recovery of dependable and representative samples from the environment. Chemical and physical analyzation methods.		

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Spring 2023

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CTK1068	**Basics of environmental protection**	5
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. 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.		

TCTK058	**Environmental legislation and administration**	5
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. 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.		

CTK1062	**Chemical engineering project**	6
Students learn to understand the different phases of organized 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. 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.		

CTK1033	**Mass transfer**	6
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. The content of the curse 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 utilizing databases in phase equilibrium problems. The course will emphasize the following unit operations of mass transfer: distillation, absorption, liquid-liquid-extraction, dissolving solids, crystallization, handling humid gases, drying, adsorption, ion exchange.

CT00AA29	**Mechanical operations in Chemical Engineering**	6
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. 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 practice mainly with the pilot scale equipment. He also learns to evaluate in writing the 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.		

CTK1063	**Wood chemistry**	5
Content: The structure of wood in theory and practice (microscopy), wood processing industry, utilization of side streams to produce new valuable materials Learning targets: Students will understand the chemical structure of wood and gain an understanding of the different possibilities for product development of wood and its fractions. Students will identify the use of fractions from the different stages of wood processing according to the principles of sustainable development.		

CTK1061	**Chemistry project**	4
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.		

CT00AA24	**Applied chemistry**	5
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.		

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, metallurgic industry, food industry.

TL1041	**Industrial economics**	5
The outcome of the course is a student knows the fundaments of industrial operations, central concepts, methods and modes of working within a company. The main topics are business economics, the characteristics of company analysis, expense concepts, contribution margin calculation, product-specific expense calculus, budgeting and investment calculations.		

CTK1058	**Biofuel production**	5
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.		

CT00AO49	**Process automation**	5
The student knows a basic knowledge of the automation instrument sensors and also has knowledge of the automation equipment and their operation. The student knows process dynamics meaning and the behavior of PID-controller and response parameters. The student knows automation system basic functions and able to evaluate automation systems for process and knows the basics of automation safety construction layout.		

CT00AQ39	**Fuel Production project**	5
The student knows the usage possibilities that alcoholic fuels or biogas have. The student is familiar with the production processes and the specialties of alcoholic fuels and biogas. The student is able to search for research data and critically read articles within the field of alcoholic fuels and biogas Research about one alcoholic fuel or biogas that could substitute gasoline, diesel (vehicles: car, truck, cargo ship, ferry, train, machines) and aviation fuel. The regional sustainable aspect is taken in account.		