



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Chemistry

### Course

Field of study

Education in Technology and Informatics

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

1/1

Profile of study

general academic

Course offered in

polish

Requirements

compulsory

### Number of hours

Lecture

20

Laboratory classes

30

Other (e.g. online)

Tutorials

Projects/seminars

### Number of credit points

4

### Lecturers

Responsible for the course/lecturer:

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### Prerequisites

Basic knowledge of chemistry and mathematics (core curriculum for secondary schools, basic level).

Ability to solve elementary problems in chemistry based on your knowledge (eg: preparation of solutions at given concentrations, handling of weights, application of a known mathematical apparatus and chemistry problems for physicochemical calculations), ability to obtain information from indicated sources. Understanding the need for further education; readiness to cooperate within the team.



### Course objective

1. Passing knowledge of chemistry to students, to the extent specified by the curriculum relevant to the field of study.
2. Developing students' ability to solve simple problems and perform simple experiments and analysis of results based on the acquired knowledge.
3. Shaping teamwork skills in students

### Course-related learning outcomes

#### Knowledge

1. The student can formulate and explain basic chemical laws in the area covered by the curriculum relevant to the field of study [K1\_W03]
2. Student can determine the basic limitations and scope of applicability of laws of chemistry and electrochemistry and give examples of their application to the description of phenomena in the surrounding world [K1\_W03]

#### Skills

1. The student can perform standard measurements of basic physicochemical quantities, estimate the time needed for their implementation and follow the schedule [K1\_U04]
2. The student can make a qualitative and quantitative analysis of the results of simple chemical experiments [K1\_U04]
3. The student can formulate conclusions based on the obtained results of calculations and measurements made [K1\_U04]
4. The student can use the understanding from the indicated sources of knowledge (list of basic literature) and gain knowledge from other sources [K1\_U01]

#### Social competences

1. The student can cooperate within the team, fulfill the responsibilities entrusted within the division of work in a team [K1\_K01]
2. The student can actively engage in solving set tasks, set priorities for the implementation of a specific task [K1\_K02]

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Autcome	Form	Assesment criteria
W01, W02, W03	written test	50.1%-70.0% (3)
		70.1%-90.0% (4)
		od 90.1% (5)



U01, U02	preparation of the report	50.1%-70.0% (3)
	oral answer	70.1%-90.0% (4)
		od 90.1% (5)
K01, K02	performing a given experiment	50.1%-70.0% (3)
	activity	70.1%-90.0% (4)
		od 90.1% (5)

## Programme content

### 1. Periodic table

Basic laws and concepts. Atom (structure, theories, quantum numbers, orbitals, the principle of expansion of electron shells). Natural and artificial atomic transformations The law of periodicity. Construction of the modern periodic table. Electronic configurations of elements and the law of periodicity. Periodicity of chemical and physical properties of elements.

### 2. Solutions

Acids, bases, salts - structure, types, preparation, properties. Electrolytic dissociation of acids, bases and salts, constant and degree of dissociation. Ion product of water. pH and pOH. Methods of pH measurement. Acid-base indicators. Acid-base titration, PK (end point) titration. Buffer solutions. Water hardness and its types. Removal of water hardness.

### 3. First law of thermodynamics

Internal energy – total energy of a system. Energy balance of the reaction (process) - internal energy balance. The difference of energy contained in products and substrates exchanged with the environment. Varieties of work: electrical, surface expansion, volumetric. How internal energy is stored. Thermal energy. Average thermal energy of particles. Maxwell-Boltzmann distribution. Temperature, its various scales. Thermodynamic temperature scale.

### 4. Second law of thermodynamics

The concept of entropy as a measure of chaos. Total entropy may increase but cannot decrease. Total entropy change as the sum of entropy system and environment changes. Zero (third) law of thermodynamics.

### 5. Phase equilibrium – one component system

Gibbs phase rule. Melting, evaporation, sublimation. Phase diagrams: liquid – vapour. Temperature dependence of vapour pressure, Clausius-Clapeyron equation. Liquid heating curves. Boiling phenomenon - boiling point. Dependence of boiling point on pressure. Heat of evaporation, heat of condensation. Cooling by evaporation of water. Cavitation. Liquid - solid transformation. Dependence of



melting point on pressure. Solid state –vapour transition: sublimation. Dependence of the vapor pressure over a solid on temperature.

#### 6. Phase equilibrium -multi component systems

Thermal analysis. Phase diagram. Liquid-gas phase equilibria for multi component systems. Distillation, fractional distillation. Azeotropes. Crude oil distillation, agricultural alcohol distillation. Liquid-solid phase equilibria for multi component systems. Crystallization, purification. Simple eutectic mixture. Eutectics of solid solutions, phase diagram. Eutectic mixture with a chemical connection between the components. Peritectic mixture. Structure of eutectic alloys. Metal alloys, examples.

#### 7. Chemical equilibrium

The equilibrium constant for reaction K. Dependence of the equilibrium constant for reaction K on temperature - van't Hoff's isotherm. Dependence of equilibrium position on temperature, isobar and isochor van't Hoff. Pressure dependence of the equilibrium position, van Laar's isotherm.

#### 8. Chemical kinetics - basic concepts

General Concepts of Kinetics. Collision Theory. Mechanisms of the Chemical Reactions – unimolecular, bimolecular and termolecular reactions. Rate of chemical reaction. Rate constant. Half-life. Order of the Chemical Reaction. Zero, first, second, and third-order rate equations. Pseudo-first-order reactions. Temperature dependence of the rate constant - Arrhenius formula. Activation Energy.

#### 9. Electrochemistry

Chemical and electrochemical depositions of metal coating. Corrosion. Protection from Corrosion. Electrolysis, Faraday's laws. Chemical and electrochemical corrosion (examples). Types of half-cells. Methods of EMF (electromotive force) determination. Types of the galvanic cells. Primary and Secondary Cells. Deposition potential. Overpotential varieties. Hydrogen overpotential. Ion mobility. Transfer number. Electric Double-Layer. Electrokinetic phenomena. Diffusion potential. Concentration cells.

#### 10. Solid -liquid adsorption

Solid-liquid adsorption. Physical and Chemical Adsorption. Heat of adsorption. Single- and multilayer adsorption. Identical adsorption centers. Isotherms of adsorption: Linear, Freundlich, Langmuir, BET equations. Adsorbents – properties. The structure of adsorbents, micro-, meso and macro-pores. Activated carbons. Capillary gas condensation. Determination of the adsorbent specific surface area from the BET isotherm. Surface modification of solid adsorbents. The use of solid adsorbents. Adsorption at the interface: liquid - liquid, liquid - gas. Gibbs adsorption isotherm. Surfactants.

### Teaching methods

Lecture: multimedia presentation



Laboratory classes: performing a given experiment as part of a laboratory exercise and preparation of the report.

## Bibliography

### Basic

1. L. Jones, P. Atkins, Chemia ogólna, PWN, W-wa 2006
2. L. Sobczyk, A. Kiszka, Chemia fizyczna dla przyrodników PWN Warszawa 1977
3. A. Lewandowski, St. Magas, Wiadomości do ćwiczeń laboratoryjnych z chemii fizycznej, WPP, Poznań 1994 (skrypt nr 1765).

### Additional

1. P. Atkins, Podstawy Chemii Fizycznej, PWN, Warszawa 1999
2. A.G. Whittaker, A.R. Mount, M.R. Heal, Krótkie wykłady. Chemia fizyczna, PWN, W-wa 2007
3. J. Minczewski, Chemia analityczna, PWN Warszawa 1975.

## Breakdown of average student's workload

	Hours	ECTS
Total workload	105	4
Classes requiring direct contact with the teacher	73	3
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) <sup>1</sup>	52	2

<sup>1</sup> delete or add other activities as appropriate