COURSE DESCRIPTION CARD - SYLLABUS

Course name
Chemistry [S1FT2>Chem]

Course

Field of study
Technical Physics

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

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Prerequisites

Basic knowledge of chemistry and mathematics (standard curriculum for secondary schools at the basic level). Ability to solve elementary chemistry problems based on the knowledge acquired (e.g., preparing solutions with specific concentrations, using scales, applying known mathematical apparatus, and chemistry topics for physicochemical calculations), ability to obtain information from indicated sources. Understanding the need for further education; readiness to cooperate within a team.

Course objective

To provide students with chemistry knowledge within the scope defined by the program content appropriate for the field of study. To develop students' ability to solve simple problems and conduct simple experiments and analyze the results based on the knowledge obtained. To shape students' teamwork skills.

Course-related learning outcomes

Knowledge:
W01: Define basic chemical concepts and quantities within the scope covered by the program content appropriate for the field of study and give simple examples of their application in the surrounding world.
W02: Formulate and explain basic chemical laws within the scope covered by the program content

appropriate for the field of study, determine the basic limitations and scope of their applicability, and give examples of application to describe phenomena in the surrounding world.

Skills:
U01: Conduct standard measurements of basic physicochemical quantities, identify and assess the importance of basic factors disturbing the measurement.
U02: Perform qualitative and quantitative analysis of the results of simple chemical experiments.
U03: Formulate conclusions based on the results of calculations and performed measurements.
U04: Use the indicated sources of knowledge (list of basic literature) with understanding and obtain knowledge from other sources.

Social competences:
K01: Cooperate within a team, fulfill the responsibilities assigned within the division of work in the team.
K02: Actively engage in solving assigned tasks, responsible for the reliability of the results of their work.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written exam: 50.1%-70.0% (grade 3), 70.1%-90.0% (grade 4), from 90.1% (grade 5)
Laboratory exercise report: 50.1%-70.0% (grade 3), oral responses: 70.1%-90.0% (grade 4), from 90.1% (grade 5)
Assessment of laboratory exercise performance: 50.1%-70.0% (grade 3), Assessment of activity during laboratory exercises: 70.1%-90.0% (grade 4), from 90.1% (grade 5)

Programme content

Elements of atomic structure. Periodic table
Basic laws and concepts. Atom (structure theories quantum numbers orbitals principle of electron shell construction). Natural and artificial atomic transformations. Periodicity law. Structure of the modern periodic table. Electron configurations of elements and the periodic law. Periodicity of chemical and physical properties of elements.
Solutions
Acids, bases, salts - structure, types, preparation, properties. Electrolytic dissociation of acids, bases, and salts constant and degree of dissociation. Ionic product of water. pH and pOH. Methods of pH measurement. Acid-base indicators. Alkalimetric titration (acid-base) PK (end point) of titration. Buffer solutions. Hardness of water and its types. Water softening.
First law of thermodynamics - conservation of energy
Concept of internal energy. Energy balance of reactions (processes) - balance of internal energy. Difference in energy contained in products and substrates exchanged with the environment. Conservation of energy law its mathematical form (first law of thermodynamics). Thermodynamic definition of work, its types. Temperature, various scales.
Second law of thermodynamics. Thermochemistry
The system tends to maximum chaos - this is the most probable state. Simple examples. Concept of entropy as a measure of chaos. Total entropy may increase but cannot decrease (second law of thermodynamics). Zero (third) law of thermodynamics. Isobaric and isochoric process. Concept of enthalpy. Heat capacity. Heat measurement - calorimeter.
Phase equilibria - single-component systems
Gibbs phase rule. Melting, vaporization, sublimation. Liquid-gas equilibrium. Dependency of the vapor pressure of a liquid on temperature: Clausius-Clapeyron equation. Liquid-solid transformation. Dependency of melting temperature on pressure. Solid-gas transformation: sublimation. Pressure-temperature dependency diagrams for liquid-gas, liquid-solid, and solid-gas equilibria. Supercritical fluid. Supercritical CO2 - phase diagram, applications.
Phase equilibria - multicomponent systems
Thermal analysis of a multicomponent system. Phase diagram. Liquid-gas phase equilibria in multicomponent systems. Azeotropy. Distillation. Rectification. Vacuum distillation. Liquid-solid phase equilibria in multicomponent systems. Simple eutectic system. Alloys examples.
Chemical reaction equilibrium. Physical chemistry of solutions
Reaction equilibrium constant. Relationship of equilibrium constant with energy and free enthalpy: van't Hoff isotherm. Dependency of equilibrium position on temperature isobar and isochor van't Hoff's law. Calculating equilibrium position and reaction efficiency from thermodynamic data. Partition equilibrium

of a component between two liquid solutions Nernst’s distribution law extraction. Osmosis. Reverse osmosis water purification. Membranes.
Chemical kinetics - basic concepts
Definition of reaction rate. Molecularity of reactions. Kinetic equations of simple single- and bimolecular reactions. Half-life period. Order of reactions. Rate constant. Pseudo-first order reactions. Dependency of the rate constant on temperature - Arrhenius equation. Activation energy of the process.
Electrochemistry
Current and non-current metal deposition. Methods of corrosion protection. Electrolysis laws of electrolysis. Chemical and electrochemical corrosion (examples). Types of electrodes and methods for measuring their potential. Cells and methods for measuring the electromotive force of cells. Types of cells. Batteries. Electrode potential. Overpotential. Types of overpotential (overvoltage). Hydrogen overvoltage. Ion mobility. Transfer numbers. Electric double layer. Electrokinetic phenomena. Diffusion potential. Concentration cells.
Adsorption on solid surfaces
Adsorption on solid surfaces. Physical and chemical adsorption. Heat of adsorption. Single- and multilayer adsorption. Active centers. Chemical adsorption Langmuir isotherm. Freundlich isotherm. Structure of adsorbents micro-, meso-, and macropores. Activated carbons. Capillary condensation of gases. BET isotherm. Determination of the specific surface area of adsorbents with the BET isotherm. Applications of solid adsorbents. Surface-active agents and their adsorption.

Course topics

none

Teaching methods

Lecture: Multimedia presentation
Laboratory exercises: Performing a given experiment as part of a laboratory exercise and written elaboration of each laboratory exercise - practical exercises.

Bibliography

Basic:
1. L. Jones, P. Atkins, Chemia ogólna, PWN, W-wa 2006
2. Z. Sarbak, Kataliza w ochronie środowiska,UAM,Poznań2004
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

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00