UNIWERSYTET GDAŃSKI

Course title Chemia fizyczna/Physical chemistry	**ECTS code** 7.2.0472

Name of unit administrating study

Faculty of Chemistry

Studies

Field of study	Type	Form	
Environmental Protection	Bachelor	Full-time studies	

Teaching staff
Prof. dr hab. Janusz Rak

Forms of classes, the realization and number of hours

A. Forms of classes, in accordance with the UG Rector's regulations
Lecture, laboratory classes

B. The realization of activities
In-class learning

C. Number of hours
lecture 30 h, laboratory classes 30 h

ECTS credits
classes - 60 h
Tutorial classes - 5 h
Student's own work - 35 h
TOTAL: 100 h - 4 ECTS

The academic cycle
Second year, summer semester

Type of course
obligatory

Language of instruction
Polish

Teaching methods

lecture with multimedia presentation
doing experiments in laboratory

Form and method of assessment and basic criteria for evaluation or examination requirements

A. Final evaluation, in accordance with the UG study regulations
Course completion (with a grade), exam

B. Assessment methods
written exam with open questions
colloquium

The basic criteria for evaluation
Scoring in accordance with the UG regulations. Passing with no less than 51% of the maximum score.
• Lecture: to qualify for the exam a student has to pass solving computational problems and doing experiments in laboratory.
• Solving computational problems: a student hast to obtain at least 51% from each of two colloquia. The final score is an average of the two partial grades. Those who do not pass take another colloquium.
• Doing experiments in laboratory: a student has to pass the entrance tests, adhere to the safety rules, obtain the correct results of experiments and carry out analysis of those results in writing (reports). The final score is an average comprising the grades of entrance tests and reports.

Required courses and introductory requirements

A. Formal requirements

Required courses: general chemistry, basics of higher mathematics and physics

B. Prerequisites

Introductory requirements: general chemistry at the level of bachelor studies, basic concepts and principles in mathematics and physics, ability to carry out chemical and physical experiments, knowledge on the construction and operation of basic chemical equipment, ability of analyzing experimental data, basic principles of occupational health and safety in chemical laboratory.

Aims of education

Familiarization of students with:
- description of reversible processes,
- functioning of nature on the basis of thermodynamics,
- physicochemical description of the adsorption phenomena,
- phenomenological description of chemical changes on the ground of chemical kinetics,
- description and applications of catalysis phenomena,
- description and use of electrochemical processes.

Acquisition of the ability to:
- understand and quantitatively describe physical changes and chemical reactions,
- use physicochemical data to prepare for studying of other subjects,
- practical implementation of various physicochemical measurements,
- prepare scientific reports describing the results, their analysis and critical interpretation.

Course contents

• Lecture issues:

fundamentals of the chemical thermodynamics of reversible processes – basic quantities and relationships between them, thermodynamic laws; phenomenological and molecular interpretation of energy and entropy; thermodynamics – basic formulas and calculations; thermodynamic criteria of chemical equilibrium, equilibrium constant; thermodynamics of ideal and real solutions; phase equilibria – phase diagrams, physicochemical grounds of the distillation and rectification processes; chemical kinetics – elemental and complex processes, theory of the absolute reaction rate; homo- and heterogenic catalysis – mechanisms, importance in technology and nature; spontaneous and non-spontaneous electrochemical processes – galvanic and electrolytic cells.

• Laboratory issues:

determining the equilibrium constant with spectroscopic measurements; calculations using the Lambert-Beer law; applications of the spectroscopic measurements; operation principle of a UV-VIS spectrophotometer; methods for determining the dipole moment; dipole moment vs. molecular structure; polarizability vs type of chemical bonds; molar refraction; type of molecular polarization; behavior of a molecule in the electric filed; determining of the refractive index; operation principle of dielectrometer; principle of calorimetric measurements (heat of combustion, calorimetric bomb, plot of the dependence of the temperature vs time, limitation of the method); liquid-vapor equilibrium diagrams for binary fully miscible solutions (isotherms and isobars); lever rule, fractional distillation of azeotropic and zeotropic mixtures; basic types of physical adsorption isotherms (Langmuir, Freundlich BET); specific surface and its calculations, application of the adsorption phenomenon; coulometry, determining the ion transport numbers; construction of conductometer; calibration of conductometer probe; determining a dissociation constant with the conductivity measurements; electrolysis process, electrolysis of aqueous solutions of acids, bases and salts; methods for determining electromotive force and activity coefficients; pH – potentiometric determination, pH meters, glass, calomel, quinhydrone and antimony electrode, electrode characteristic; determining activation energy; influence of a catalyst on reaction progress; precise control of the temperature.

Bibliography of literature

A. Literature required to pass the course

Chemia fizyczna. K. Pigoń, Z. Ruziewicz (2005) PWN
Praca zbiorowa, red. W. Moska, Ćwiczenia laboratoryjne z chemii fizycznej i fizyki chemicznej, Wydawnictwo UG, Gdańsk 1992.
P.W. Atkins, Podstawy chemii fizycznej, PWN Warszawa 1999.
P.W. Atkins, Chemia fizyczna, PWN Warszawa 2001.
P.W. Atkins, C.A. Trapp, M.P. Cady, C. Giunta, Chemia fizyczna. Zbiór zadań z rozwiązaniami, PWN Warszawa 2001.

B. Extracurricular readings

Praca zbiorowa, Chemia fizyczna, PWN Warszawa, 1980.
G.M. Barrow, Chemia fizyczna, PWN Warszawa 1971.
R. Brdićka, Podstawy chemii fizycznej, PWN Warszawa 1970.
T. Drapała: Chemia fizyczna z zadaniami, PWN 1976.
L. Sobczyk, A. Kisza, Chemia fizyczna dla przyrodników, PWN 1975.
Chemia fizyczna. Ćwiczenia laboratoryjne. red. H. Strzelecki, W. Grzybkowski, PG (2004).