



Subject card

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| Subject name and code | , PG_00048764 | | | | | | |
| Field of study | Green Technologies | | | | | | |
| Date of commencement of studies | October 2020 | Academic year of realisation of subject | | | 2021/2022 | | |
| Education level | first-cycle studies | Subject group | | | Obligatory subject group in the field of study Subject group related to scientific research in the field of study | | |
| Mode of study | Full-time studies | Mode of delivery | | | at the university | | |
| Year of study | 2 | Language of instruction | | | English | | |
| Semester of study | 4 | ECTS credits | | | 6.0 | | |
| Learning profile | general academic profile | Assessment form | | | exam | | |
| Conducting unit | Department of Physical Chemistry -> Faculty of Chemistry | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Maciej Śmiechowski | | | | | |
| | Teachers | dr hab. inż. Maciej Śmiechowski dr hab. inż. Adam Kloskowski | | | | | |
| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 30.0 | 15.0 | 45.0 | 0.0 | 0.0 | 90 |
| | E-learning hours included: 0.0 | | | | | | |
| Adresy na platformie eNauczanie: Physical Chemistry for Green Technologies summer 2021/22 - Moodle ID: 20969 https://enauzanie.pg.edu.pl/moodle/course/view.php?id=20969 | | | | | | | |
| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM | | |
| | Number of study hours | 90 | 5.0 | 55.0 | 150 | | |
| Subject objectives | The aim of the subject is familiarizing the students with basic concepts in electrochemistry, chemical kinetics and surface science. | | | | | | |
| Learning outcomes | Course outcome | Subject outcome | | | Method of verification | | |
| | [K6_U03] is able to use information and communication technologies relevant to the common tasks of engineering, is able to use known methods and mathematical-physical models to describe and explain phenomena and chemical processes | Preparation of reports from performed experiments. Estimation of accuracy and precision of experimental results. Knowledge of databases in physical chemistry. | | | [SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment | | |
| | [K6_W02] has a basic knowledge of chemistry including general chemistry, inorganic, organic, physical, analytical, including the knowledge necessary to describe and understand the phenomena and chemical processes occurring in the environment; measurement and the determination of the parameters of these processes. | Knowledge of basic laws of physical chemistry and their applications in solving simple technological problems. | | | [SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge | | |

| Subject contents | <p>Electrochemistry: Electrolyte solutions. Electrical conductivity. Conductometry. Theory of strong electrolytes. Ionic activity coefficients. Debye-Hückel Law. Ionic mobility. Transference numbers. Electrodes. Faradays Laws. Hittorf method. Coulometry. Selected electrolytic processes. Thermodynamics of galvanic cells. Half-cells and their classification. Standard reduction potentials. The electrochemical series. Potentiometry. Determination of pH. Electrodesolution interface. Interfacial potentials. Electrode polarization. Galvanic sources of energy. Introduction to corrosion.</p> <p>Chemical kinetics: Reaction rates. Rate law and rate constant. Reaction order. Rate constant and reaction order determination. Elementary reactions. Arrhenius Law. Reversible, parallel and consecutive reactions. Complex reaction mechanisms. Steady state approximation. Rate law theories: collision theory, transition state theory. Homogeneous and heterogeneous catalysis. Enzymatic catalysis. Lindemann-Hinshelwood mechanism. Michaelis-Menten mechanism. Chain reactions. Explosion. Polymerisation. Introduction to electrochemical kinetics.</p> <p>Surface science: Interfacial phenomena. Surface tension and its measurement. Cohesion and adhesion. Kelvin equation. Surface active agents. Adsorption on liquid-gas interface. Gibbs adsorption isotherm. Micelles and layers. Structure of colloidal particles. Electrokinetic phenomena. Coalescence and coagulation. Adsorption on solid-gas interface. Langmuir isotherm. BET isotherm. Thermodynamic description of adsorption.</p> | | | | | | | | | | | | | | | | | |
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| Prerequisites and co-requisites | Knowledge of basic mathematics, physics and general chemistry as obtained during the first year of studies in chemical sciences. | | | | | | | | | | | | | | | | | |
| Assessment methods and criteria | <table border="1" data-bbox="448 710 1487 904"> <thead> <tr> <th data-bbox="448 710 794 745">Subject passing criteria</th> <th data-bbox="794 710 1141 745">Passing threshold</th> <th data-bbox="1141 710 1487 745">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 745 794 801">performing laboratory exercises and submitting lab reports</td> <td data-bbox="794 745 1141 801">100.0%</td> <td data-bbox="1141 745 1487 801">10.0%</td> </tr> <tr> <td data-bbox="448 801 794 837">entry test in laboratory exercises</td> <td data-bbox="794 801 1141 837">50.0%</td> <td data-bbox="1141 801 1487 837">20.0%</td> </tr> <tr> <td data-bbox="448 837 794 873">2 written tests in tutorials</td> <td data-bbox="794 837 1141 873">50.0%</td> <td data-bbox="1141 837 1487 873">30.0%</td> </tr> <tr> <td data-bbox="448 873 794 904">final exam</td> <td data-bbox="794 873 1141 904">50.0%</td> <td data-bbox="1141 873 1487 904">40.0%</td> </tr> </tbody> </table> | | | Subject passing criteria | Passing threshold | Percentage of the final grade | performing laboratory exercises and submitting lab reports | 100.0% | 10.0% | entry test in laboratory exercises | 50.0% | 20.0% | 2 written tests in tutorials | 50.0% | 30.0% | final exam | 50.0% | 40.0% |
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| Recommended reading | <table border="1" data-bbox="448 911 1487 1424"> <tbody> <tr> <td data-bbox="448 911 794 1093">Basic literature</td> <td colspan="2" data-bbox="794 911 1487 1093"> 1. P. W. Atkins, General Chemistry, Scientific American Books, 1992. 2. P. Atkins, J. de Paula, J. Keeler, Atkins Physical Chemistry, Oxford University Press, 2018. </td> </tr> <tr> <td data-bbox="448 1093 794 1328">Supplementary literature</td> <td colspan="2" data-bbox="794 1093 1487 1328"> 1. Chemistry LibreTexts, Physical & Theoretical Chemistry, https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps 2. H. DeVoe, Thermodynamics and Chemistry, http://www2.chem.umd.edu/thermobook/ </td> </tr> <tr> <td data-bbox="448 1328 794 1424">eResources addresses</td> <td colspan="2" data-bbox="794 1328 1487 1424">Physical Chemistry for Green Technologies summer 2021/22 - Moodle ID: 20969 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=20969</td> </tr> </tbody> </table> | | | Basic literature | 1. P. W. Atkins, General Chemistry, Scientific American Books, 1992. 2. P. Atkins, J. de Paula, J. Keeler, Atkins Physical Chemistry, Oxford University Press, 2018. | | Supplementary literature | 1. Chemistry LibreTexts, Physical & Theoretical Chemistry, https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps 2. H. DeVoe, Thermodynamics and Chemistry, http://www2.chem.umd.edu/thermobook/ | | eResources addresses | Physical Chemistry for Green Technologies summer 2021/22 - Moodle ID: 20969 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=20969 | | | | | | | |
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| <p>Example issues/ example questions/ tasks being completed</p> | <ol style="list-style-type: none"> 1. Write the half reaction (always as reduction) and the Nernst equation for given half-cells. 2. Write half-reactions occurring during electrolysis in the followings systems: Pt NaCl(aq) Pt, Cu CuSO₄(aq) Pt, Ag AgBr HBr(aq) Pt. 3. Draw a graph presenting the titration curve for a strong base titrated by a weak acid. Write an example of such titration and thoroughly explain the shape of the curve. 4. Given the cell Co(s) CoCl₂(aq; 1.0 mol/dm³) AgCl(s) Ag(s) answer the questions below. 5. Derive the equation permitting to calculate the time, after which the concentration of reactant X decreases to one-twelfth (1/12) of its initial value in a second order reaction. 6. On the diagram draw a linearized plot of transformed concentration of reactant X vs. time for reactions of 2nd order. Clearly mark the axes, label the intercept and write equation of the line. 7. Given the half-time of a first order reaction: R → P (100 s), determine the time, after which the concentration of reactant R falls down to 1/8 of its initial value. 8. Draw a graph showing a linearized adsorption isosthere, write down its equation, and demonstrate how to obtain a relevant thermodynamic parameter characterizing the adsorption process from this plot. 9. Draw a graph showing the Langmuir isotherm, write down its equation, and demonstrate the limiting behavior of the curve. |
| <p>Work placement</p> | <p>Not applicable</p> |