Course title: **Physical Chemistry**

Institute/Division: **Department of Biotechnology and Physical Chemistry / FACULTY OF CHEMICAL ENGINEERING AND TECHNOLOGY**

Number of contact hours: **75 hours** (30 h lectures, 15 h problem solving and 30 h laboratory)
Course duration: 1 semester (5th semester of regular I cycle studies – fall/winter)
ETCS credits: **6**

Course description:

Lectures. The following topics will be addressed: The properties of gases. The First Law of thermodynamics. Thermodynamic state functions. Hess's law. Standard enthalpies of formation and combustion. The temperature-dependence of reaction enthalpies. Entropy. The Second and Third Laws of thermodynamics. The Helmholtz and Gibbs energies. The chemical potential. Chemical equilibrium. Le Chatelier's principle. The van't Hoff equation. Physical transformations of pure substances. Phase diagrams. The Clausius–Clapeyron equation. The thermodynamic description of mixtures. Phase diagrams of binary and ternary systems. Intermolecular interactions. Surface tension.

Adsorption processes and their quantitative description. Electrochemistry: structures of contemporary galvanic cells, the Nernst equation, electrode potentials, conductivity of electrolytes. Chemical kinetics: kinetic equations, temperature dependence of reaction rates, catalysis.

Problem Solving will cover calculations in thermochemistry and thermodynamic equilibria.

Laboratories will involve the following experiments: Viscosity of liquids. Surface tension. Vapour-Liquid Equilibrium. Adsorption from a liquid phase. Potential of galvanic cells. Kinetics of ester hydrolysis.

Education effects:

- knowledge: Understanding the fundamentals of chemical thermodynamics and the significance of state functions and their changes in determining the physical and chemical equilibria, and the spontaneity of chemical reactions and phase transitions. Understanding the fundamentals of electrochemical equilibria and the structure of electrochemical cells. Getting knowledge of adsorption phenomena and laws of chemical kinetics, including catalysis.
- skills: Students will acquire the ability to calculate the values of thermodynamic state functions, to predict equilibrium composition of a reaction mixture, and its composition after a defined reaction time. They will also be able to perform physicochemical measurements and interpret the results of such measurements.
- social: Enhancing teamwork and communication skills

Literature: [1] Peter Atkins, Julio de Paula and James Keeler, "Atkins' Physical Chemistry", 11th Edition, Oxford University Press 2018.

Assessment method: Midterm Exam (Problem Solving), Check-in Quizzes and reports from each experiment (Laboratory), Final Exams.
Prerequisites: Basic knowledge of General Chemistry and Physics, and experience with calculus.
Primary target group: All Chemical Technology, Chemical Engineering and Biotechnology Students

Lecturers: Dr Stefan S. Kurek, PhD; Dr Roman Popielarz, PhD, DSc; Dr Piotr P. Romańczyk, PhD, DSc
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Remarks: Regular course