Tárgytematika / Course Description

Physical chemistry

MENB_ÉTTA016

Tárgyfelelős neve / Teacher's name: dr. Ajtony Zsolt
Félév / Semester: 2021/22/2
Beszámolási forma / Assesment: Vizsga
Tárgy heti óraszáma / Teaching hours(week): 2/0/0
Tárgy féléves óraszáma / Teaching hours(sem.): 0/0/0

OKTATÁS CÉLJA / AIM OF THE COURSE

The course aims to provide basic knowledge in physical chemistry based on the store of learning of mathematics, physics, general and inorganic chemistry and to help you to understand and learn the subjects of food chemistry, food analysis I-II and food technology.

TANTÁRGY TARTALMA / DESCRIPTION

Topic

1) Basic Terms of Thermodinamics
System and surroundings. Open, closed and, isolated systems. Homogeneous, inhomogeneous, heterogeneous systems; state variables (quantities), extensive and intensive quantities (volume, pressure, amount of substance); reversible, irreversible processes; the zeroth law of thermodynamics. Ideal gases, state variables of single component gases, temperature scales; ideal gas law, isotherms of ideal gases; Dalton's Law. Real gases: compressibility factor, compressibility diagram, Boyle temperature; state equations of real gases: viral equation, van der Waals equation; isotherms of real gases, critical temperature, critical pressure.

2) First Law of Thermodynamics
Thermodynamic functions: state function, process function; internal energy; first law of thermodynamics; expansion work. the change of internal energy and enthalpy, total derivative of internal energy and enthalpy, Joule’s attempt; Joule-Thomson effect; heat capacity, heat capacity of gases; temperature dependence of enthalpy. Thermochemistry: general equation of chemical reaction, stoichiometric coefficient, standard state, standard enthalpy of reaction, standard molar enthalpy of formation, calculation the reaction enthalpy, Hess’s law, Kirchhoff’s law.

3) Second and Third Law of Thermodynamics
Equivalent wording of the second law; definition and properties of entropy, entropy law, Clausius inequality. Thermal power engines: definition of thermal power engine, maximum efficiency of thermal power engine, Carnot efficiency, Carnot cycle of ideal gas, thermodynamic temperature scale, heat pump. Statistical interpretation of entropy, third law of thermodynamics, unification first and second law. Thermodynamic potential functions: Helmholtz energy, Gibbs energy. Pressure and temperature

dependence of Gibbs energy, Gibbs-Helmholtz equation, standard Gibbs energy of reaction, standard molar Gibbs energy of formation, standard Gibbs energy of chemical reactions, direction of chemical processes

4) Phase Transitions

Homogeneous, inhomogeneous heterogeneous systems. Phases, phase equilibria, allotropic transformations, polymorphic transformations. Clapeyron equation, Clausius-Clapeyron equation. Boiling point, melting point, triple point; boiling point dependence on pressure. Phase diagrams: Phase diagram of carbon dioxide and water. Phase rule.

5) Mixtures I.

Mixtures, unlimited mixing, limited mixing, solubility. Concentration units. Ideal mixtures: definition of ideal mixtures; extensive quantities change during mixing, H, G, S, V changes during the formation of ideal mixtures. Partial molar quantities: chemical potential, chemical potential of ideal and real mixtures.

6) Mixtures II.

Vapor tension of ideal mixtures: Raoult's law, vapor tension of ideal binary mixtures. Vapor pressure of real mixtures: Henry's law, vapor pressure and boiling point curves of real mixtures. Distillation. Eutectic compounds. Colligative properties: elevation of boiling point, depression of freezing point, osmosis pressure. Van't Hoff equation.

7) Chemical Equilibria

Equilibrium state in chemical reaction. Equilibrium constant, Gibbs energy change of equilibrium reaction. Thermodynamic condition of chemical equilibrium. Equilibrium constant dependence on the equilibrium pressure and equilibrium temperature. Le-Chatelier-Braun principle.

8) Interfacial Phenomena

Surface tension, Eötvös rule, parachor, vapor pressure of curved surface, capillary height. Adsorption, physisorption and chemisorption, active locations, Langmuir isotherm, BET-isotherm.

9) Transport Phenomena

Dynamic and kinematic viscosity. Newtonian and non Newtonian fluids. Temperature dependence of viscosity of gases and fluids. Arrhenius-Andrade relation. Stokes's law. Hagen-Poiseuille's law. Diffusion, convection. Fick's first and second law. Thermal conductivity, heat flux density, Fourier's law. Thermodiffusion (Soret-effect), Onsager's principle, transport processes.

10) Basic Term of Kinetics

Reaction rate, rate law, reaction order, partial order of reaction, reaction rate constant, half life time. Kinetics of first order and second order decay, consecutive and parallel reactions.

11) Mechanism of Chemical Reactions

Elementary reactions. Molecularity. Temperature dependence of rate constant. (Arrhenius-equation). Step-wise reaction, rate determining step, quasi-steady-state approximation (Bodenstein), rapid equilibrium assumption, high concentration of reactant. Chain reactions

12) Conduction of electrolytes

Conductivity, molar conductivity, measurement of conductivity. Galvanic cell, electrode potential, standard electrode potential, electromotive force, Nernst equitation.

13) Electrodes

Electrode of the first kind, electrode of the second kind, redox electrode, H_2 electrode, glass electrode, pH measurement. Electrolysis, electrolytic cell, Faraday's second law of electrolysis, deposition potential, overpotential.

SZÁMONKÉRÉSI ÉS ÉRTÉKELÉSI RENDSZERE / ASSESMENT'S METHOD

Examinations:

Written comprehensive exam in the exam period.
The use of cell phones, graphing or programmable calculators, or
data transmitting devices, such as smartwatches, will not be permitted during the exam.

KÖTELEZŐ IRODALOM / OBLIGATORY MATERIAL

Literatures:

Atkins, P.; & de Paula, J.: Elements of Physical Chemistry, Fifth Edition, Oxford University Press, 2005

Bahl Arun, Bahl, B.S., Tuli, G.D: Essentials of Physical Chemistry

Novák, J. P.; Labík, S.; Malijevská, I. : Physical Chemistry in Brief. Institute of Chemical Technology, Faculty of Chemical Engineering, Prague, 2005. http://old.vscht.cz/fch/en/tools/breviary-online.pdf

Schartl, W : Basic Physical Chemistry. A complete Introduction on Bachelorof Science level, Schartl, W & bookboon.com, 2014.
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=2ahUKEwi2iePJs7LmAhU8UBUIHVjvAMIQFjABegQIShAC&url=http%3A%2F%2Fdspace.bhos.edu.az%2Fxmlui%2Fbitstream%2Fhandle%2F123456789%2F840%2Fbasic-physical-chemistry.pdf%3Fsequence%3D1&usg=AOvVaw1hNWuV64mGMec1GpVAq0VI

Whittaker, A.G., Mount, A.R. & Heal, M. R.: Instant Notes. Physical Chemistry, Department of Chemistry, University of Edinburgh, Edinburgh, UK, BIOS Scientific Publishers Limited, 2000.
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&ved=2ahUKEwi2iePJs7LmAhU8UBUIHVjvAMIQFjAGegQIKhAC&url=https%3A%2F%2Fwww.mobt3ath.com%2Fuplode%2Fbook%2Fbook-60839.pdf&usg=AOvVaw0tQKiMLZ1lpw_bbn1EJVlA