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| **Title and Code** of the subject:  **Physical chemistry MTBE7008A.** | **ECTS Credit Points: 4** |
| **Type** of the subject: compulsory | |
| **Ratio of theory and practice: 50/50** (credit%) | |
| **Type and number of classes per semester**: 28 hour(s) lecture and 28 hour(s) practice per **semester**  Number of teaching hours / week:2+2 (lecture and practice) | |
| **Type of exam**: practical course mark | |
| **Subject in the curriculum:** semester | |
| Preliminary requirements:- | |

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| **Summary of content - theory**: |
| Course objectives  **Schedule:**   1. Basic concepts of the chemical thermodynamics: System, wall and features. Extensive and intensive properties. Temperature, internal energy. 2. Main laws of thermodynamics. Work, volume work cycle. 3. Enthalpy. Material and energy balances. Entropy and its calculation. Thermodynamic potential functions. The thermodynamic system of relationships. Euler and Gibbs-Duhem equation. Equilibrium conditions for extensive and intensive parameters. 4. One-component systems: gases. Ideal gas state. 5. Isothermal and adiabatic process. Poisson equation. Real gas equation of state. Van der Waals equation. Liquids. 6. Gibbs phase rule. Clausius-Clapeyron equation. Phase diagram of water. Multi-component systems. 7. Mixtures. Partial molar quantities. Ideal mixtures. Dalton's Law. The chemical potential. Realistic mixtures, activity. 8. Binary mixtures of vapor-liquid equilibrium. Raoult's Law. Azeotropic mixtures. The Basics of distillation. 9. Colligitave traits. Dilute solutions, vapor pressure and boiling point increase decrease. Freezing point depression. Osmotic pressure and its biological significance. Gas dissolution fluid. Henry's law. Mutual solubility of liquids. Limited immiscible liquids. Immiscible liquids. 10. Steam distillation. Partition coefficient. Dissolution of solids and liquid, the solubility is a function of temperature. Mutual solubility of solids. 11. Chemical equilibrium. The equilibrium constant and the standard free energy change of reaction. Van't Hoff equation, exothermic and endothermic reactions. The equilibrium constant changes in pressure, Le Chatelier-Braun principle. 12. Reaction kinetics, basic concepts of reaction rate, half-life. Simple reaction rate equations. Complex reactions. Consecutive and parallel reactions. Chain Reaction. Arrhenius equation. Homogeneous and heterogeneous catalysis. Enzyme catalysis. 13. Basic concepts of electrochemistry. Electrolytic dissociation, conductivity, Kohlrausch rule. Ostwald's dilution law. Solubility. Galvanic and electrode potentials. Electrodes. Redox potentials. Concentration elements. The forms of corrosion. Corrosion current and potential. Corrosion protection 14. Heat transport |
| **Summary of content - practice**: |
| **Schedule:**  Calculations in physical chemistry:   1. Exercise 1. Concentration units and their conversion 2. Exercise 2. Density calculation 3. Exercise 3. Ideal gas related calculations 4. Exercise 4. Calculation of volumetric work 5. Exercise 5. Calculation of energy in heating and cooling 6. Exercise 6. Energy conversion of phase transition 7. Exercise 7. Chemical reactions energy calculation 8. Exercise 8. Calculations related to Clausius-Clapeiron equation 9. Exercise 9. Dilute solutions laws 10. Exercise 10. Equbrillium calculations 11. Exercise 11. Calculatioins of reaction rate 12. Exercise 12. Electrochemisal equbrillium calculations 13. Exercise 13. Heat transfer calculations 14. Exercise 14. prctical problems solution with calculations |
| **Literature, handbooks in English** |
| 1. Atkins, P.W.: Fizikai Kémia I-III. Budapest, 1998. 2. Atkins, P.W.: Fizikai Kémia I-III. A tankönyvi feladatok megoldásai. Budapest, 1998. 3. Atkins,W.,P.: Physical Chemistry, Oxford University Press, 1990. 4. Chang, R.: Physical Chemistry with Applications to Biological Systems, Macmillan Publishing Co. New York, 1977. |
| **Competencies gained** *(acc. to the Regulation on training and outcome requirements)* |
| 1. **Knowledge:**  * Have a good understanding of the basics of physical chemistry.  1. **Skills:**  * The student can identify specific problems and opportunities in the calculations of chemical processes.  1. **Attitude:**  * Committed to his/her profession, he/she knows and undertakes its core values and norms, strives to critically interpret and develop them, and solve problems on a professional basis. * The student recognizes values in the field of chemical calculations. |

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| **Responsible lecturer: Dr. Prokisch József** |
| **Terms of course completion:** |
| Written test for problem solving with calculations and application of theoretical principles |
| **Form of examination:** |
| Written test |
| **Requirement(s) to get signature:** |
| taking part of 80% of practice |
| **Exam questions:** |
| 1. Basic concepts of the chemical thermodynamics: System, wall and features. Extensive and intensive properties. Temperature, internal energy. 2. Main laws of thermodynamics. 3. Work, volume work cycle. Heat, enthalpy. 4. Entropy and its calculation. Thermodynamic potential functions. 5. One-component systems: gases. Ideal gas state. Isothermal and adiabatic process. 6. Gibbs phase rule. Clausius-Clapeyron equation. Phase diagram of water and CO2. 7. Multi-component systems. Mixtures. Ideal mixtures. Dalton's Law. Binary mixtures of vapor-liquid equilibrium. Raoult's Law. The Basics of distillation. 8. Colligitave properties. Vapor pressure and boiling point increase. Freezing point depression. Osmotic pressure and its biological significance. 9. A gas mixture consists of 2 g of hydrogen and 10 g of methane. The total pressure of the gas mixture was 253.31 kPa. Calculate the partial pressure of methane. 10. How many Joules need to heat 180 g of water from 20 oC to 70 oC? The heat capacity of water is 37 J/molK. MH2O=18 g/mol 11. Calculate the value of volumetric work by evaporating 5.2 mol ammonia at the boiling point of ammonia at -33 oC under normal atmospheric pressure? 12. How much heat is released when 72 g of zinc is cooled from 180 °C to 35 °C and the metallic zinc has a molar heat capacity of 24.85 J mol-1? MZn = 63 13. The osmotic pressure of a 0.1% protein solution at 20 ° C is 2.1 kPa. What is the molar mass of the protein? The protein solution had a density of 1 g / cm3 14. What is the boiling point of the water at 10000 m height, where the air pressure is 26,000 Pa. Evaporational heat of water is 40,600 J/mol |