**General information**

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| Course title: | PHYSICAL CHEMISTRY |
| ISVU[[1]](#footnote-1) course code: | 38328 |
| Studies in which the course is taught: | Professional studies in Food Technology |
| Course Instructor: | Jasna Halambek, Ph.D., Senior lecturer |
| Course Assistant: |  |
| ECTS credits: | 5 |
| Semester of the course execution: | II |
| Academic year: | 2022/2023 |
| Exam prerequisites: | General and inorganic chemistry, Mathematic 1 |
| Lectures are given in a foreign language: | English |
| Aims: | Introduction to the basic laws of physical chemistry, through thermodynamic and kinetic approach to physical and chemical changes, and their application in the analysis and interpretation of experimental results. |

**Course**

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| Course structure | Number of contact hours per week: | Number of contact hours per semester: | Student’s requirements by type of teaching: |
| Lectures: | 2 | 30 | attendence 80% |
| Tutorials: | - | - |  |
| Practical (lab) sessions: | 2 | 30 | attendance 80% |
| Seminars: | - | - |  |
| Field work: | - | - |  |
| Other: | - | - |  |
| TOTAL: | 4 | 60 |  |

**Monitoring of students' work, knowledge evaluation and learning outcomes**

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| Formation of the grade during the implementation of teaching:  (Define from minimum 5 to maximum 10 learning outcomes) | **LEARNING OUTCOMES**  (upon completion of the course the student should be able to:) | **FACTORS AFFECTING THE GRADE** (e.g. term paper, practical work, presentation, ...) | **MAXIMUM NUMBER OF POINTS PER FACTOR** |
| **I1:** Define the fundamental laws of physical chemistry relating to gases and thermodynamic processes. | Preliminary exam I | Preliminary exam I: 25 points  Preliminary exam II: 25 points  Oral exam:30 points  Lab practice: 20 points |
| **I2:** Distinguish the concepts of internal energy, enthalpy and entropy, and connect them with the laws of chemical thermodynamics. | Preliminary exam I |
| **I3:** Explain the concept of the chemical potential and the basic laws of chemical equilibrium. | Preliminary exam I |
| **I4:** Compare the phase equilibrium and colligative properties of solutions. | Preliminary exam II |
| **I5:** Apply the acquired knowledge to solve problems related to the viscosity, surface tension, adsorption and diffusion. | Preliminary exam II |
| **I6:** Recognize problems related to electrochemistry, chemical kinetics, and describe dispersed systems. | Preliminary exam II |
| Alternative formation of the grade  ( I 1 – I 10) | **or alternative formation of the grade: I 1 – I 6**  Final written and oral exam - 80% of the final grade– I1, I2, I3, I4, I5, I6  Lab practice – 20% of the final grade. | | TOTAL: 100 points |
| Students' competencies | Ability to apply the basic principles of physical chemistry in solving various physico-chemical problems, as well as, analysis and interpretation of measurement results. | | |

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| Prerequisites for course approval (lecturer’s signature): | Class attendance 80% and completed laboratory practice 100% |
| Prerequisites for taking exams: | Lecturer’s signature. |
| Grading scale: | (According to the Regulations on student assessment of Karlovac University of Applied Sciences, Article 9, Paragraph 5) 90-100 - excellent (5) (A) 80 to 89.9 - very good (4) (B) 65 to 79.9 - good (3) (C) 60 to 64.9 - sufficient (2) (D) 50 to 59.9 - sufficient (2) (E) 0 to 49.9 – fail (1) (F)  Students are graded during class, what forms 70% of final exam. Students who achieve 50% (35 points) and more are allowed to take the final exam. The score on final exam makes 30% of the final grade. |

**ECTS structure**

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| ECTS credits allocated to the course reflect the total burden to the student during adoption of the course content. Total contact hours, relative gravity of the content, effort required for exam preparation, as well as, every other possible burden are taken in account: | | | | | |
| **Attendance (active participation)** | **Term paper** | **Composition** | **Presentation** | **Continuous assessment and evaluation** | **Practical work** |
| **0,2** |  |  |  |  | **1** |
| **Independent work** | **Project** | **Written exam** | **Oral exam** | **Other** | |
|  |  | **2** | **1,8** |  | |

**Review of topics/units per week associated with learning outcomes**

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| Week | Lectures topics/units and learning outcomes: | Tutorials topics/units and learning outcomes: |
| 1. | Introduction and basic concepts in physical chemistry. The characteristics of the states of matter. **I1** | Introduction to the physical chemistry laboratory- measuring devices and treatment of experimental data **I1** |
| 2. | The ideal gases and ideal gas mixtures. The kinetic theory of gases. **I1** | Verification of Boyle -Mariotte law. **I1** |
| 3. | Real gases. Van der Waals equation for real gases. The critical variable. **I1** | Determination of the molar volume of a gas at standard temperature. **I1** |
| 4. | The internal energy. The first law of thermodynamics. Isothermal and adiabatic work. Enthalpy. **I2** | Calorimetry- determination of heat of neutralization. **I2** |
| 5. | Chemical thermodynamics. Thermochemical laws. **I2** | Thermochemistry -determination of the heat capacity and integral enthalpy of salt. **I2** |
| 6. | The second law of thermodynamics. Carnot cycle. Entropy. **I2** | Nernst's distribution law. **I3** |
| 7. | The change in entropy. Free energy and enthalpy. Gibbs-Helmholtz equation. **I3** | Cryoscopy and ebullioscopy (determination of the molar mass of a sample). **I4** |
| 8. | Mixed phase. Partial molar quantities. Chemical potential. **I3** | Liquid-vapor phase diagram-isobaric distillation. **I4** |
| 9. | Chemical equilibrium. **I3** | Potentiometric titration. **I5** |
| 10. | Phase equilibria. Colligative properties of solutions. **I4** | Conductometric titration. **I5** |
| 11. | Equilibria at the phase boundaries (viscosity, surface tension). **I5** | Viscosity of liquids - Ostwald viscometer.  Surface tension-stalagmometer. **I5** |
| 12. | Diffusion. Adsorption. Adsorption isotherms. **I5** | Acid adsorption on activated carbon- determination of constant in Freundlich adsorption isotherm. **I5** |
| 13. | The conductivity of the electrolyte. EMF. **I6** | Conductivity determination of the strong and weak electrolytes. Electromotive force of a galvanic cell. **I6** |
| 14. | The kinetics of chemical reactions. **I6** | Polarimetry-inversion of sucrose (calculation of reaction-rate constants). **I6** |
| 15. | Dispersed systems. **I6** | Preparation of emulsion. Measuring the current values of different emulsion types. **I6** |

**References**

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| REFERENCES (compulsory/additional): |
| 1. P. Atkins, J. de Paula, Physical Chemistry, 9th edition, Oxford University Press, Oxford 2009. 2. P. Atkins, J. de Paula, Physical Chemistry for Life Sciences, Oxford University Press, Oxford, 2006. |

**Exams for the academic year:** 2022/2023

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| Exam dates: | According to the schedule of exams for current academic year |

**Contact information**

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| 1. Course Instructor/Lecturer: | Jasna Halambek, Ph.D., Senior lecturer |
| e-mail: | jhalambek@vuka.hr |
| Office hours / Consultations: | Strossmayer Square 9, room113/1 (with previous arrangement on e-mail) |
| 2. Course Instructor/Lecturer: |  |
| e-mail: |  |
| Office hours / Consultations: |  |

1. ISVU – Information System of Higher Education Institutions in Croatia [↑](#footnote-ref-1)