COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
DEPARTMENT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	ISCED level 6 – Bachelor's or equivalent level		
COURSE CODE	YN303	**SEMESTER**	3rd Semester
COURSE TITLE	Physical Chemistry I		

TEACHING ACTIVITIES *If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	4 Th +3 Lab	7
Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.		

COURSE TYPE *Background, General Knowledge, Scientific Area, Skill Development*	General Background
PREREQUISITES:	
TEACHING & EXAMINATION LANGUAGE:	Greek
COURSE OFFERED TO ERASMUS STUDENTS:	NO
COURSE URL:	https://eclass2.emt.duth.gr/courses/CHEM_C105/

(2) LEARNING OUTCOMES

Learning Outcomes
Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

At the end of the course, students will be able to solve problems using thermodynamic methods.
The objectives of the Physical Chemistry Laboratory are: a) to familiarize students with the laboratory environment and the use of instruments, equipment, and reagents, b) to teach laboratory techniques and experimental skills, and c) to consolidate knowledge of physical chemistry by linking theory and experiment.
Upon completion of the laboratory, students will have acquired the knowledge and skills to:

- Understand physicochemical processes related to electrochemistry, surface physicochemistry, and the physicochemical properties of fluids.
- Become familiar with and perfect the process of preparing a project in which physicochemical calculations are performed and diagrams are produced from which the required physicochemical parameter is derived.
- Process and present the results of the experimental exercises performed
- Knowledge and understanding of the basic concepts, principles, and theories related to the physicochemical fields of electrochemistry, the study of surfaces, and the physicochemical properties of fluids.

The students' work in the Physical Chemistry Laboratory will cultivate critical thinking and scientific reasoning, enhance self-motivation and active learning, while also developing team spirit and cooperation through group work in the laboratory.

General Skills
Name the desirable general skills upon successful completion of the module
Search, analysis and synthesis of data and information, Project design and management

ICT Use	*Equity and Inclusion*
Adaptation to new situations	*Respect for the natural environment*
Decision making	*Sustainability*
Autonomous work	*Demonstration of social, professional and moral responsibility and*
Teamwork	*sensitivity to gender issues*
Working in an international environment	*Critical thinking*
Working in an interdisciplinary environment	*Promoting free, creative and inductive reasoning*
Production of new research ideas	

Working in an interdisciplinary environment
Generating new research ideas
Respect for the natural environment
Exercising criticism and self-criticism
Promoting free, creative, and inductive thinking
The general skills acquired by students and targeted by the laboratory course are:

- Theoretical thinking and the ability to convert theoretical knowledge into solving and finding experimental parameters
- The ability to apply knowledge acquired during their studies in related courses of the Department's PPE
- Ability to search for, analyze, and synthesize data and information from the international literature and use the necessary technologies related to the presentation of research results
- Acquisition of the appropriate practical knowledge background to enable further education at the postgraduate level
- Working in an interdisciplinary environment
- Ability to collaborate at the team level to achieve the above objectives

(3) COURSE CONTENT

THEORY

1. Fundamental concepts. The relationship between molecular and macroscopic properties. Basic concepts of thermodynamics.
2. The properties of gases. The states of gases. The laws of gases. Molecular interactions. The Van der Waals equation.
3. First law of thermodynamics. Work, heat, and energy. Internal energy. Work of expansion. Enthalpy. Adiabatic changes.
4. Thermochemistry. Normal enthalpy changes. Enthalpies of formation and chemical reactions. Temperature dependence of enthalpy. State functions. Relationship between CV and Cp.
5. Second law of thermodynamics. Spontaneous changes. Entropy and entropic changes. Third law of thermodynamics. Helmholtz and Gibbs energies of a system.
6. Combination of the first and second laws of thermodynamics. Fundamental equation, Maxwell relations. Properties of internal energy and Gibbs energy.
7. Physical transformations of pure substances. Phase diagrams of pure substances. The thermodynamic criterion of equilibrium. Chemical potential. Claussius–Clapeyron equation. Ehrenfest classification of phase transitions. Liquids and liquid surfaces. Surface tension.
8. Simple mixtures. Thermodynamic description of mixtures. Some molar properties, additive properties.
9. Phase diagrams of binary systems. Liquid-gas phase diagram, azeotropic phase diagram, liquid-liquid phase diagram, solid-liquid phase diagram, eutectic phase diagram. Energies
10. Chemical equilibrium. Equilibrium constants, exothermic-endothermic reactions, Van't Hoff equation.
11. Electrochemistry of equilibrium. Galvanic cells, Nernst equation, standard electrode potentials.
12. Fundamental concepts. The relationship between molecular and macroscopic properties. Basic concepts of thermodynamics.
13. Properties of gases. States of gases. Gas laws. Molecular interactions. Van der Waals equation.

LABORATORY

1. Determination of physicochemical properties of fluids (i) Density, (ii) Viscosity
2. Determination of molecular weight (Victor Meyer method)
3. Study of gas behavior - Gay Lussac's law
4. Thermochemistry: Heat capacity - Enthalpy of dissolution
5. Surface tension of solutions (Ring method - DU NOUY balance)
6. Determination of molar surface tension (EOTVOS rule)
7. Refractometry I: Determination of refractive index
8. Refractometry II: Determination of sugar content in samples using refractometry
9. Azeotropic mixtures
10. Electrochemistry I: Electrochemical flocculation – Chemical flocculation
11. Electrochemistry II: Electrooxidation - Anodic Oxidation
12. Electrochemistry III: Electro-Fenton
13. Electrochemistry IV: Study of Faraday's Laws - Copper Coulometer

(4) LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD *Face to face, Distance learning, etc.*	Lectures on the board Face-to-face tutorials and laboratory exercises
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) *Use of ICT in Teaching, in Laboratory Education, in Communication with students*	**THEORY** Use of ICT (Power point) in Teaching More than 200 multiple-choice questions using the click questions method (based on the MIT model). **LABORATORY** Use of ICT (PowerPoint and video) in teaching. Support for the learning process through the e-class electronic platform. Specifically, the slides from the tutorials, the theory and experimental instructions are posted, the pre-lab test is conducted, and the lab reports are submitted. Communication with students via email, answering questions.
TEACHING ORGANIZATION *The ways and methods of teaching are described in detail.* *Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.* *The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.*	

Activity	Workload/semester
Lectures and problems (4 hours x 13 weeks) Laboratory exercises (3 hours per week x 13 weeks)	91
Final exam (3 hours)	3
Student study hours, preparation for progress and final exam	70
Laboratory report	11
Total Course Hours 25 hours per credit	175 Total workload

STUDENT EVALUATION *Description of the evaluation process* *Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others* *Please indicate all relevant information about the course assessment and how students are informed*	**Student evaluation methods** Written final exam on Theory Minimum passing grade: 5 The lab grade is determined by the following: i. Careful and successful execution of experiments—Lab participation, grade A1, 5% ii. The lab notebook, which includes the presentation and evaluation of the experimental results and questions to reinforce the material, grade A2, 25%

	iii. The midterm written exam on the material covered in the laboratory exercises (progress), grade B1, 35% iv. The final written exam on the material covered in the laboratory exercises, grade B2, 35% The final overall grade for the course "Physical Chemistry Laboratory I" is calculated as follows: Final grade = {A1}x0.05 + {A2}x0.25 + {B1}x0.35 + {B2}x0.35 At the end of each semester, there is a week of make-up laboratory exercises. Students who have been absent once (1) during the current semester are eligible to participate. If a student has more than one absence, they must repeat the missed laboratory experiments in the following academic year. Students who have been absent from more than four laboratory exercises (≥4) must re-register for the course in a future semester and repeat all experiments. Successful completion of all laboratory experiments is a prerequisite for students to take the final written exam. If a student has completed the laboratory part of the exercises but has a laboratory grade lower than 5, they are given the opportunity to participate in a partial laboratory exam in September. The final overall grade for the course is calculated as follows: Final grade = {Theory}x0.60 + {Laboratory}x0.40

(5) SUGGESTED BIBLIOGRAPHY

THEORY

1. P. Atkins, J. De Paula, Φυσικοχημεία, Πανεπιστημιακές εκδόσεις Κρήτης (2015).
2. Δ. Α. Γιαννακουδάκη, Μαθήματα Θερμοδυναμικής και Φ. Χημείας, Θεσ/νικη (1975).
3. Ν. Κατσάνος, Φυσικοχημεία: βασική θεώρηση, εκδόσεις Παπαζήση (1998).
4. W.J. Moore, Physical Chemistry, Longmans 4th ed. London (1962).
5. I.N. Levine Physical Chemistry, 6th ed., Mc Graw Hill, New York (2009).
6. L.C. Labowitz, J.S. Arents, Problems in Physical Chemistry Khosla Pub. (1995).

Related scientific journals:

1. Journal of Chemical Education
2. The Physics Teacher
3. Journal of Engineering Science and Technology Review

LABORATORY

1. David R. Lide, CRC Handbook of Chemistry and Physics, 84th Ed., 2003-2004
2. ΦΥΣΙΚΟΧΗΜΕΙΑ, , ATKINS PETER - DE PAULA JULIO, ISBN: 978-960-524-431-6, ΙΔΡΥΜΑ ΤΕΧΝΟΛΟΓΙΑΣ & ΕΡΕΥΝΑΣ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ
3. Α. Γιαννακουδάκης, Μ. Σιγάλας, Π.Γιαννακουδάκης, Υβριδικές Εργαστηριακές Ασκήσεις σε θέματα Φυσικής Χημείας, Εκδόσεις Τζιόλα

Related scientific journals:

Journal of Chemical Education

Journal of Physical Chemistry