Physical Chemistry-1

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 232**	**SEMESTER**	**2nd**
COURSE TITLE			

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	5
Seminars	1	
Laboratory work	-	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Basic Physical Chemistry).
PREREQUISITE COURSES:	Typically, there are not prerequisite course, but the students should possess, at least, basic knowledge of Mathematics
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Understands the transport phenomena
2. Describes an ideal gas model and by that to deduct and describe its fundamental properties (energy states and state functions).
3. Expands the ideal gas model to the real gases.
4. Understands and apply the first, the second and the third law of thermodynamics.
5. Defines the fundamental energy functions that come from the first law of thermodynamics and from that to be able answers the following questions:
   a) How a system can be defined

b) Which is the work that a chemical reaction produces c) Which are the changes in the state functions of the system that happen in a chemical reaction 6. Defines the fundamental energy functions that come from the second law of thermodynamics and from that to be able answers the following questions: a) Which are the changes in the state functions of the system that happen in a chemical reaction b) When a chemical reaction is spontaneous c) How a heat engine works 7. Construct a graph of energy function and explains them 8. Analyses the changes of state in physical transformations 9. Describes the systems response of equilibria in physical transformations
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
By the end of this course the student will, furthermore, have developed the following skills (general abilities): 1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to Chemical Thermodynamics and Changes of State. 2. Uses this knowledge for describing with mathematical models various physical and chemical systems. 3. Uses this knowledge for solving problems related to mass transfer and chemical reactions procedures. 4. Abilities in studding and understanding various concepts in Fields of Science (Natural Sciences, and Medical Sciences) as well as in Industry. 5. Ability to apply this knowledge in experiments which involved in physicochemical systems.

3. SYLLABUS

1. The properties of gases, the compression factor, Virial coefficients, the van der Waals equation, the real gases–the perfect gases, equation of state, the kinetic theory of gases, $pV=nRT$, mean speed of molecules in a gas, the Maxwell-Boltzmann distribution of speeds, the collision frequency, the mean free path, collisions with walls and surfaces, Graham's law of effusion, Transport properties– theoretical determination of the diffusion coefficient of the Fick's law, thermal conduction and viscosity, Poiseuille's equation.
2. The First Law of Thermodynamics, open–closed–isolated system, work–heat–energy of the system, internal energy of a system, intensive–extensive properties, the first thermal engine of James Watt, reversible changes– p-V diagrams, adiabatic changes, definition of C_p, C_V, step functions–inexact differentials, state functions-exact differentials, gas internal pressure π_T, expansion coefficient α, isothermal compressibility κ_T, The Joule-Thomson effect and the coefficient $t\mu_T$, $C_p-C_V=\alpha(p+\pi_T)V$, isothermal expansion of a perfect gas, adiabatic reversible expansion, heat capacity ratio $\gamma=C_p/C_V$.
3. The Second Law of Thermodynamics, Entropy, the change in entropy for isothermal reversible expansion of a perfect gas, spontaneous and non-spontaneous changes, The Zeroth Law of Thermodynamics, The Third Law of Thermodynamics, thermodynamic engineering, heat pumps, Carnot cycle in p-V plot, the Clausius inequality and the definition of the Enthalpy, Gibbs and Helmholtz energy, functions, combining the First and Second Laws: the Maxwell relations, derivation of the $\pi_T = T(\partial p/\partial T)_V - p$, derivation of the Gibbs-Helmholtz equations:

$[\partial(G/T)/\partial(1/T)]_p=H$ and $[\partial(A/T)/\partial(1/T)]_V=U$, chemical potential of real and perfect gases, fugacity.

4. Thermodynamics supplementary: derivation of the $\Delta S=nR\ln(V_f/V_i)+C_V\ln(T_f/T_i)$, mathematical definition of a reversible change, Carnot cycle in S-T plot, efficient of a heat engine, the third law of thermo-dynamics and the impossibility of reaching absolute zero of temperature, analysis of the Joule-Thomson effect, $\mu=[V(\alpha T-1)/C_p]$, Linde refrigerator and liquefied air.
5. Physical transformations, melting, boiling, sublimation, μ-T plot, the temperature and pressure dependence of chemical potential, Clapeyron equation μ-T and p-T phase diagram, the solid-liquid boundary, the liquid-vapour boundary, the solid-vapour boundary, partial molar quantities, the Gibbs-Duhem equation, the Gibbs energy of two ideal-gases mixing, Francois Rault's and Henry's laws, colligative properties, the elevation of boiling point, the depression of freezing point, Osmosis, liquid-vapour equilibrium, the distillation of mixtures, Azeotropes, J.W. Gibbs' phase rule.

4. TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures and tutorials in the amphitheatre. Face to face teaching by the active participation of students with questions and exemplary solution of problems related to the theory.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of Information and Communication Technologies (ICTs) (PowerPoint) in teaching.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (3 contact hours per week x 13 weeks)</td><td>39</td></tr>
<tr><td>Tutorials (1 contact hour per week x 13 weeks) - solving of representative problems</td><td>13</td></tr>
<tr><td>Final examination (3 contact hours for Physical Chemistry 1)</td><td>3</td></tr>
<tr><td>Hours for private study of the student</td><td>70</td></tr>
<tr><td>Course total</td><td>125</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>1. Two (2) optional written progress during the Semester
2. Final written examination
Greek grading scale: 1 to 10. Minimum passing grade: 5.</td></tr>
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5. ATTACHED BIBLIOGRAPHY

1. P.W. Atkins, "Physical Chemistry", Volume I, Translation: S. Anastasiadis, G.N. Papatheodorou, S. Farados, G. Fitas, Creta University Press,2005.
2. N.Th. Rakintzis, "Physical Chemistry", 3rd Edition, Papasotiriou Edition, 1994.
3. E. Dallas, "Physical Chemistry", Publications of University of Patras.